ELECTRICAL REVIEW

ILLUSTRATED.

A WEEKLY JOURNAL OF

Electric Light, Power, Telephone, Telegraph and Scientific Progress.

VOL. 17, No. 10. WEEKLY. | NEW YORK, SATURDAY, NOVEMBER 1, 1890. | $3 per annum. Single Copies, 10 Cents.

Copyright, 1890, by ELECTRICAL REVIEW PUBLISHING COMPANY, 13 Park Row, New York.

Entered at Post Office, New York, as Mail Matter of the Second Class.

The Eickemeyer Street Car Motor.

On October 23, a member of the REVIEW staff witnessed a trial of the Eickemeyer street car motor referred to in our issue of October 18, which conclusively demonstrated that gearing is not demanded for successful electric traction. In the trial machine, a 12 inch Eickemeyer armature was connected with the front wheels of the car by connecting rods journaled on six inch cranks, the two cranks being set at a right angle so as to leave no dead point. The motor is supported on springs. The crank connection of the armature with the connecting rods is of a ball and socket type to compensate the lateral thrust of the motor and prevent lateral strain on the connecting rods. The motor occupied a space of about two feet square by 18 inches deep under the car body. The coils were of No. 8 B. & S. wire, the entire ohmic resistance of the motor being 5 ohms, and that of the armature .7 of an ohm. The field coils were arranged so as to be cut in in sections by means of a rotary commutator, supported near the motor and controlled by a lever at the front of the car. The maximum armature speed was about 150 per minute when the car moved at the rate of about eight miles per hour. There is absolutely no noise except that due to the wheels on the rails and the friction of the carbon brushes on the commutator segments. The latter could be heard by reason of the fact that the floor of the motor had been removed so that the operation of the mechanism could be seen from the inside of the car. The accomplishment of this very desirable result of coupling the armature spindle directly to the drive-wheels is rendered possible by the high counter electro-motive force developed in the Eickemeyer motor. The motor is constructed on the same principle as the well-known Eickemeyer dynamo, the machine being entirely sheathed in iron and all of the lines of force being led through the armature, thus avoiding all loss due to air leakage in the machines as ordinarily constructed. An intensely dense magnetic field is created, which not only exerts a powerful torque in the armature, but which develops a high counter E.M.F. at a low armature speed. The potential of the circuit was about 270 volts, and at no time during the run of the motor, when it took speeds varying from zero to eight miles per hour, did the ampere meter indicate a greater flow than 35 amperes, varying from this at the starting point down to a normal consumption of about 20 amperes. The start was smooth and quick.

A street railway in Lynchburg will be equipped with six of these motors, which are now being made by Messrs. Oesterheld & Eickemeyer, Yonkers, N. Y.

After exhaustive experiments, the French post office has decided to substitute a copper-coated steel wire in place of the ordinary iron wire for telegraphic and telephonic service.

A New United States Dynamo.

The United States Electric Lighting Company, of Newark, N. J., has just put upon the market a new type of dynamo, which embraces some novelties in construction and design. The general appearance of the machine is very tasteful, as will be seen from the illustration on this page.

The dynamos manufactured by the United States Company are classed as lighting machines and generators. The subject of our illustration is a 100 horse-power, 500 volts, compound wound, direct current generator, designed to run at 400 revolutions per minute. The same type of dynamo is also used for lighting machines at 110 and 250 volts. The capacity as a 110 volt lighting machine is 1,000 sixteen candle-power lamps.

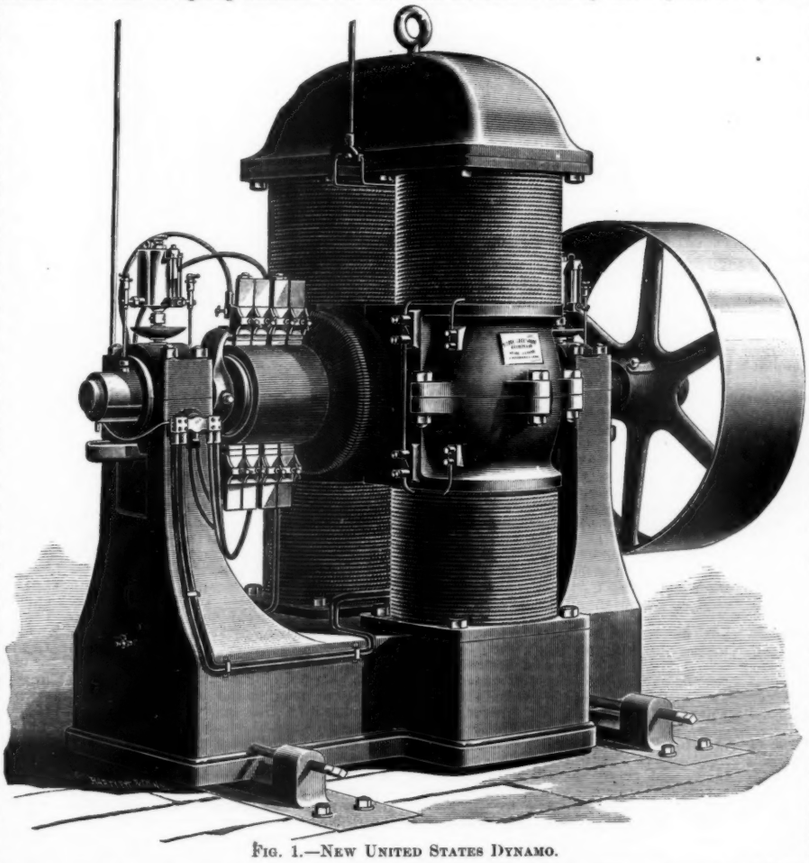


FIG. 1.—NEW UNITED STATES DYNAMO.

A 200 horse-power generator of the same design is also made. This runs at 300 revolutions per minute, and when made as a lighting machine, at 110 volts, has a capacity of 2,000 lamps of 16 candle-power each. A detail illustration of the brush holder with carbon brushes is shown on page 115. This brush holder is used on all 500-volt dynamos.

The 100 horse-power generator is 92¾" high, occupies a floor space 47½" by 73⅜", is driven by a pulley 36" in diameter and 15½" face, has 75,000 watts capacity, and weighs 22,000 pounds. The 200 horse-power size is 92⅞" high, takes up a floor space 7', 5¼" by 4', 8¾", is of 150,000 watts capacity, and weighs 45,000 pounds.

It will be noticed that the floor space occupied, considering the size of the generator, is very small. The armature speed is very low.

All Watches Compasses.

A few days ago I was standing by an American gentleman, when I expressed a wish to know which point was the north. He at once pulled out his watch, looked at it, and pointed to the north. I asked him whether he had a compass attached to his watch. "All watches," he replied, "are compasses." Then he explained to me how this was. Point the hour hand to the sun and the south is exactly half way between the hour and the figure XII on the watch. For instance, suppose that it is 4 o'clock. Point the hand indicating four to the sun and II on the watch is exactly south. Suppose that it is 8 o'clock, point the hand indicating eight to the sun, and the figure X on the watch is due south. My American friend was quite surprised that I did not know this. Thinking that very possibly I was ignorant of a thing that every one else knew, and happening to meet Mr. Stanley, I asked that eminent traveler whether he was aware of this simple mode of discovering the points of the compass. He said that he had never heard of it. I presume, therefore, that the world is in the same state of ignorance. Amalfi is proud of having been the home of the inventor of the compass. I do not know what town boasts of my American friend as a citizen.—*London Truth.*

History of Electric Lighting.

Electric lighting, says M. Fontaine, did not make its appearance until near the close of the year 1873. It was in Paris, in November, 1873, in the workshop of M. Gramme, that the first installation on a really industrial scale of electric lighting took place, by means of a continuous dynamo and Serrin regulators. It was also in Paris, in 1877, that the Jablochkoff candle was first employed; 16 lights distributed over a distance of about 1,100 yards, being supplied by a single alternate current Gramme machine. Paris, therefore, had the honor of possessing the first public and private lighting produced by means of electric currents. M. Fontaine thinks that in 1891 or 1892 the electric lighting in Paris will require for its production motive force equal in round numbers, to 32,000 horse-power.

Frankfort Exhibition.

Great preparations are being made to make the forthcoming electrical exhibition at Frankfort-on-the-Main a success. Among the many different and attractive features to increase the public interest in electrotechnics, it is intended to connect the Exhibition by telephone with the concert hall Palmengarten, the Frankfort Opera House, both with a number of ordinary telephones, and with large loud speaking instruments for a larger audience. Several pieces of apparatus, with nickel-in-the-slot mechanism, will be in connection with the watering places near Frankfort, the Court Theatre, at Mannheim, and the opera of Munich.

Galvanic Current Generated by Muscular Action.

There is a reference to the experiments of Dubois-Reymond in De la Rive's "Traité d'Electricité, III," p. 38, of which the following is a free translation: "The observer dips the fingers of both hands in two vessels of salt water connected to the terminals of a very sensitive galvanometer (27,000 turns of wire) by means of slips of platinum completely deprived of electro-motive force. When the needle has come to rest, he contracts as strongly as possible all the muscles of one arm, taking care not to move the fingers in the liquid. At this instant the galvanometer receives an impulse indicating a current from hand to shoulder of the contracted arm." Then follow theoretical conclusions, and further on it is stated that a greater effect is produced if the skin is first removed from the arm at points placed in connection with the galvanometer.

A fire from an unknown cause did $12,000 damage to the station of the Lynn, Mass., Electric Lighting Company early in the morning of October 26. The city was in darkness for a few hours. The burning of the dynamo connections threw an overload on the large Corliss engine. The governor gave out, and the 34 foot fly wheel revolved at an abnormal rate, finally bursting.

The Civilian Electrician in Modern War.

ADDRESS OF LIEUTENANT BRADLEY A. FISKE, U. S. N., BEFORE THE NEW YORK ELECTRICAL SOCIETY, OCTOBER 23, 1890.

I beg to propose for your consideration this evening a plan by which, in time of war, all the electrical resources of New York, both in supplies and in men, will become at once available for the defense of the country and the city.

It is well known to all here that electricity has come into use as one of the great factors in warfare, both on sea and shore, not as an adjunct merely, as for lighting ships and forts, but as a vital element in the handling of weapons in actual battle, and in the construction of new instruments, which accomplish things heretofore impossible.

I desire to recall to your recollection a few of the most important uses to which electricity is now put in warfare, to indicate some of the probable paths of future development, to show that it would be impossible for our regular navy and army to adequately handle the vast electrical work that would have to be instantly done in time of sudden war, and to suggest a plan for coming to their assistance.

The science of electrical engineering is now recognized as one of the most necessary of the practical sciences of the world. It stands out as distinct and defined as the science of medicine or the science of astronomy. It enters into thousands of the departments of daily life, but in no other department is it used in so various and so important ways as in warfare. This is so much the case, that the prophecy is sometimes ventured that in the near future nations will fight by electricity. Though this, like all extreme statements, requires modification, yet the number of ways in which electricity has come to be applied within the last eight years, is calculated to inspire the liveliest anticipations as to the developments of the next eight years. No vessel pretending to modern equipment goes to sea without a complete electric plant for furnishing light. This light is so much more suited to ship life than any other light, that we now wonder that we ever went to sea without it. The electric motor is coming into use for ventilating ships, and it is beginning to be used for training guns and the hoisting to the deck of shot and shell. The best and most accurate results at target practice are attained when the guns are fired by electricity. Range finders give the gunner constant knowledge of what he must know, *i.e.*, the distance of the enemy. The best means of night signaling, and the one adopted in nearly every navy in the world, is by means of incandescent lights. The electric search-light is almost as much a feature of the equipment of a modern warship as are her guns and her torpedoes. In the actual use of the Whitehead & Howell torpedoes, electricity plays an important part. The telephone is now coming into use for ship work, and will unquestionably supplant the speaking tube, which is acknowledged in all navies to be unsatisfactory. In fact, we find all through modern warships an increasing use of electricity. The reason is clear. The modern warship is the most intricate, tremendous and powerful machine existing. In no other equal space can be found so many, so various and so important kinds of apparatus. Everything must be done which will put her absolutely within the grasp of the captain. She must respond at once to his command, and her whole strength and power must be his, as though she were a part of him. Ensconced in his armored conning tower, he must be the brain of the gigantic body. Electric wires must convey instant tidings to him from her innermost recesses, and electric wires flash back from him the inevitable command. In this way only can a modern ship, no matter how large, how strong, how heavily armored or how swift, completely fulfill her mission and be a perfect fighting machine.

What is true of ships is equally true of forts. The power of ships' guns has so increased that it has become necessary to protect shore batteries by iron and steel instead of masonry, as in the days not long gone by, and, in addition, to use disappearing carriages wherever it can be done. Disappearing carriages, as is well known, are so arranged that the gun disappears below the parapet of the fort when the gun is fired, and remains out of sight and safe during the operation of loading, so that it is exposed only for a short time, when it is raised to fire. Now, without the aid of electricity, a very considerable time would elapse, even after the gun was raised, before it could be fired; because the gun would have to be trained in the proper direction and be elevated to the proper degree for propelling its projectile over the distance between it and the enemy. To estimate this distance and make the proper adjustments would entail delay, and would be absolutely impossible if smoke obscured the target, as would be the case during a great portion of the time. But electricity, acting through the medium of the position finder, gives the gunners continuous information of the distance and direction of the enemy, no matter how thick the smoke; so that they know exactly what to do before the gun is raised to fire.

Electricity, furthermore, gives the commanding officer complete control of all the different groups of guns and mortars in his fort. Noting the progress of the action from a station aloof from the smoke and noise, he can direct the concentration of as many batteries as he thinks best on one ship, or can disperse the fire as much as circumstances from time to time dictate.

For the handling of the monster apparatus used in forts, the guns, the carriages, the ammunition, electricity is rapidly coming to the front. Some power must be used since the muscles of men are too weak. Hydraulic power has been used hitherto; but for many purposes electricity has the same advantages over hydraulics that have caused its unprecedented advance in the other departments of engineering throughout the world, while for repelling a night attack from ships, the search-light has been found by repeated trials in the naval manœuvres abroad to be simply indispensable to the land defense.

For military service in the field, there is not an army in the civilized world that has not its military telegraph service. One great cause of the suddenness and completeness of the Germany victory in 1870, was the rapid mobilization of the Prussian army, and its appearance on the frontier ready for battle. Now, the splendid efficiency of the telegraph service in the hands of the military authorities made this possible. Nothing is more important in warfare than despatch in moving the enormous bodies of men of which modern armies are composed, with all their ammunition, equipments and numberless accessories. To move a quarter of a million men to the frontier in a single day, means a good deal; and to manœuvre so large a body of men with such precision and rapidity that no one division shall have to wait for any other division, simply cannot be done without electricity.

But the most immediate and important use of electricity in the defense of a coast is in the submarine mine or ground torpedo.

Defending a harbor with submarine mines is simply carrying out, with more or less elaboration, a system by which a large number of water-tight tanks, each holding from 100 to 1,000 pounds of gun-cotton or other explosive, are anchored in carefully defined positions, and connected by armored electric cables with protected operating rooms, in which are batteries, measuring instruments, etc. The more complete mines have usually floating above them automatic circuit closers, in which two contact points are joined together by a passing ship, and thus afford a passage for the electric current to the fuse in the torpedo.

Now, these mines are some of them exceedingly large and heavy, and the electrical apparatus, while simple to the mind of a trained electrician, yet must be made and adjusted with great care. The torpedoes, as a system, must be constructed, laid down and connected to the operating rooms on shore by long and heavy armored cables. The operation of practically planting and connecting the necessary submarine mines for New York would be a stupendous undertaking. Kindly bear this in mind until I recur to it again.

We have now seen, after a rough survey of the subject, that electricity has already acquired an acknowledged position in the art of war, and that the uses to which it is put are not trivial ones. Electricity is not used in warfare as a convenience, nor is it a fad of theorists; it fires the guns, it discloses the stealthy approach of the torpedo boat at night, it directs the proper elevation of the guns; in fact, it does good, honest, practical work. But note this point, also: In every one of these applications of electricity we have to pay, in one way, for what we get by studying the ways in which electricity will work for us. We cannot expect electricity to work for us unless we treat her properly. We cannot handle electrical apparatus with carelessness and ignorance, and expect that it will work when we need it. In other words, we find in warfare, as in everything else to which electricity is applied, that electricians are useful.

This remark doubtless seems absurdly commonplace, but it is intended to suggest that, in war time, electricians, even civilian electricians, may suddenly become very useful to the government. A captain of a fine ship might lose an action from simply a lack of knowledge as to some electrical appliance on his part, or on the part of some subordinate; some small accident might break a circuit just at a critical juncture, which might prevent the communication of an order, the receiving of information or the firing of a torpedo, at a crisis; and yet, the cause might be such that a man with even a very slight knowledge could remedy the difficulty in a second by the mere pressure of his finger; but that pressure not being given, the action might be lost, and from that cause alone.

Let us now glance at some of the other uses of electricity to which it would probably be put in case of an attack upon New York. There can be no reasonable doubt that Lay torpedoes, Patrick torpedoes, Sims-Edison torpedoes and Halpine-Savage torpedoes, would come to the front at once. The enemy's fleet being daily expected off Sandy Hook, we should see the advocates of these systems, under authority of the general government preparing stations at Coney Island, Sandy Hook and elsewhere, for the launching of their dreadful missiles against his iron-clads. The question of ballooning, both for observation and for the dropping of explosives on his decks, would be taken up at once, and the electrical world would be agitated anew over the question of balloon propulsion by electricity. Electric launches, arranged to carry torpedoes, would be fitted out to noiselessly steal out at night on their errands of destruction. Electric picket boats of smaller size, perhaps, would scout the waters in pursuit of information or to convey despatches; electric submarine boats would spring into being by the dozen and, filled with adventurous spirits, would seek the enemy, secure from detection below the surface of the sea and carrying enough explosives to utterly destroy the proudest warship of the world.

It will now be apparent that in the case of a sudden war (and most wars are sudden), there will be an immense amount of work to be done in the electrical line alone. Could our regular army and navy do all this work in the time allowed? It is probably known to all here that our regular navy and army are simply a nucleus around which fighting forces could be formed. They are so small, as regards both officers and men, that they can barely carry on the work in time of peace, and would be wholly inadequate in time of war. We should not have enough battle ships, monitors, cruisers or torpedo boats; we should not have enough forts; we should not have enough sailors; we should not have enough infantry; we should not have enough artillery; we should not have enough electricians. Take the single matter of laying out and connecting up the submarine mines in New York harbor. This is an area covering many square miles, in parts of which the mines would be placed at frequent intervals; every mine being accurately secured in its designated place and connected by cable to the operating room, perhaps miles away. The mere labor of constructing, fitting and filling one mine, and afterwards taking it out into the harbor and lowering it into place, with all its connections, is no small task; and what can be said of the task of doing this with hundreds of submarine mines? Then the work of properly arranging the various cable connections, testing apparatus, firing apparatus, etc., necessary for the efficient action of the mines would follow. The Board on Ordnance and Fortification have designed all the torpedo defenses, but they will not be in practical operation, probably, for many years, and a war may come meanwhile. But it is certain that on the outbreak of any war, an immense amount of this work would have to be immediately done, because we will never keep the submarine defenses of New York harbor on a war footing in time of peace.

The navy department would be even more hurried. We should certainly be called upon to commission a great many warships and to equip as commerce-destroyers a great many merchant steamships; we should have to do all the things that we did on the outbreak of our last war, and, in addition, we should be confronted with the necessity of fitting all kinds of fine apparatus, the necessity of fitting electrical appliances of all descriptions, besides securing gun-circles in place with mathematical precision, and of accomplishing all the manifold fine work that is required with the ordnance, navigation and engineering equipment of a warship of the present day. And as to fitting on merchant ships, who is going to fit them out? This operation requires technical knowledge. Who has it? How many of the merchant steamship captains would be able to install and manage a battery of even Hotchkiss or Driggs-Schroeder guns, or could remedy an accident to either gun or ammunition?

It being apparent that the regular army and navy in event of a sudden war would be unable to handle all the electrical work that would certainly be thrown upon them, I will propose the formation of a corps of naval and military electricians to assist the regular army and navy in its work. Such a corps might exist in every principal seaport town on the coast; the principal one, of course, being the corps with headquarters in New York. Electricity being now a recognized factor in both naval and military war, and requiring expert electricians for its full development, there would seem to be just as much reason for an electrical corps in the National Guard of the State of New York, as for infantry, artillery or cavalry. While the members of this corps would be men of technical knowledge, and while its sphere of usefulness in war would be because of that technical knowledge, it is obvious that the organization should be a military one, and that with some modifications it should be governed by the same principles as govern all military bodies. Being a military body under the governor of the State, it could at once become available on the outbreak of war.

It would seem that this corps, like all other corps, should be composed of men of various ranks, subject to various duties. Many kinds of work would have to be done in war, and many kinds of men would be required to do them. On the outbreak of war, certain members would naturally elect duty in the navy; others in the army. The most obvious and immediate employment would doubtless be in the torpedo defense of the harbor, under the direction of the general commanding. And who can doubt the gratification which that general would feel, when suddenly ordered to defend New York harbor, on finding ordered to his list of subordinates a hundred or more capable electrical engineers, young, enterprising, accustomed to difficult electrical work, familiar not only with electricity in its technical features, but also acquainted with the electrical people of New York, with its factories, its places of business and its methods of business. These men would become available in a day, and could be at once set to work in carrying out the details of the vast and complicated system. Their work need not be confined to that purely electrical in character, because every electrical engineer is, by training and of necessity, a mechanician, and every sort of apparatus would be readily understood by him, and a very slight training will make him master of it. Those members volunteering for naval work would be equally useful. The ordnance officer at the Navy Yard would suddenly find himself overwhelmed with a mass of work which he would be utterly unable to carry out without assistance of some such sort as this. And for the reason that electrical engineers are, of necessity, mechanicians, a great deal of technical work could be entrusted to them; such as the arrangement and fitting of gun carriages, the storage of ammunition, the assembling of guns, etc. Their more immediate and obvious field, however, would be the installation and fitting of electric lights, motors, telegraphs, telephones and other electrical appliances, on board the vessels of war suddenly called into requisition. In the matter of fitting out merchant steamships, their usefulness would be at once apparent. The number of regular officers would be found utterly out of proportion to the number of ships; the whole navy would have to undergo an expansion. Only a very few regular officers could be assigned to each vessel; so that the majority of officers would have to be volunteer officers, as was the case in our civil war. During the first part of the war, the command of the different vessels would naturally be entrusted to regular officers, leaving the other positions to be filled by volunteers. Now, as the commander of a ship is head of all the departments of a ship, he cannot give much personal attention to one special department. Therefore, the general arrangement and fitting out of all vessels, both regular warships and merchant steamships, would have to be largely entrusted to volunteers in all that relates to the electric and ordnance equipments. Now, as the work of fitting out ships with electric and ordnance equipments calls for technical knowledge and experience of a high character, it is obvious that a corps of well-trained technical men, such as here suggested, would be more than useful—they would be necessary. A further field for employment of such a corps in time of war is suggested by the fact that the genius of our people tends towards constant invention and improvement of all sorts of machinery and apparatus, and our history has shown that every war has brought into being many inventions in weapons of defense and offense. Can it be doubted, then, that any future war would produce more such inventions? And, in view of the great progress of electrical science since the last war, and, in further view of the great number of electricians in New York, can it be doubted that many of these inventions would be electrical in character? Under the stimulus of a national peril, and with the resources of New York at command, it is certain that important and novel warlike applications of electricity would at once spring into being. And while our regular forces of both army and navy were employed on their specific duties, what more natural than that some new Ericsson should arise, and some new "Monitor" or other craft startle the nations of the world? Therefore, besides the obvious uses to which such a corps as this might be placed, there are other uses, no less important, of inventing, constructing and using weapons of defense, the nature of which we cannot as yet even faintly conceive. And as few heroes of our late war go down to history with more glory than has Ericsson, so, perhaps, our next war may produce some electrician, now unknown, whose fame will outlive the ages.

It would seem as if such a corps as this could be formed under existing laws, and that there would be no difficulty in enlisting members. The attractions of the Naval Reserve and the National Guard seem sufficient to induce a large membership in the different regiments, and there is no reason why membership in an electric regiment should not be

equally desirable and confer equal distinction. The qualifications for entrance, as regards education and intelligence, would be greater than those for any other regiment, corps or battalion. Its military and naval usefulness would be acknowledged, and its position, in all respects, would be one of dignity. The larger the membership, the better; provided, of course, that due care be observed in excluding undesirable persons. The whole electrical influence of New York and of the country would be at its back, with all its millions of dollars and its men of world-wide fame; and there is no reason why it should not acquire a national influence. The course of instruction could be readily carried out, embracing the naval and military applications of the purely technical science, with which the members are already familiar, instruction being given by regular navy and army officers detailed for the purpose. This instruction would naturally embrace the construction and care of apparatus. It being presupp that there are different ranks in this c , the system of instruction will naturally differ with the different ranks. With the higher ranks it would naturally embrace the theory and practice of gunnery, navigation, including compasses, and seamanship. Steam engineering would probably not need to be taught, it being assumed that the members require very little instruction in that branch. For the lower ranks, the scheme of instruction need not include much more than the handling and care of the different apparatus. On the outbreak of war, the members volunteering for the different services could be subjected to certain examinations, and their rank determined by the proficiency exhibited. As to the detail of organization, uniform, etc., these need not be entered into here, as they can obviously be settled at any future time. My only purpose now is to propose to you a plan for meeting an emergency, which may some day arise. I would hazard the suggestion that the corps or battalion should at first include about 250 members, and that it should be officered, uniformed and drilled in much the same ways as the other corps of the National Guard. I would even advocate a certain amount of infantry drill as a means of instilling the military idea. Occasional runs in the torpedo boat "Cushing," and frequent short trips out to sea for target practice in modern warships, would be essential. There would be considerable work, but there would be many compensating, social and other advantages. I have ventured, with much diffidence, to advance this idea, but earnestly hope that you will think it worthy of earnest consideration. My only excuse for broaching it is, that it has been in my mind for many years, that it has been commended by every man to whom I have spoken about it, and that I have been urged to bring it to the attention of the electricians of New York.

New England Portelectric Company.

Professor A. E. Dolbear, electrician of the New England Portelectric Company, has made the following report to the president and directors of that company:

GENTLEMEN:—The work of the experimental station in Dorchester has been carried on without interruption from the beginning, although there have been delays from many causes—some from failure to receive the apparatus when due, and many from lack of experience to enable us to foresee all the mechanical contingencies that arose as the work progressed. As the whole project was new, every detail needed to be worked out independently, and it is hardly necessary to say that many of these details needed both ingenuity and patience to work out properly.

The chief of these has been to adapt the car to the compound curve, made up of a grade and a curve of short radius, which has needlessly handicapped the enterprise from the start.

The finished track is an oval, 2,784 feet long, with two grades, one of 8 feet, the other of 11 feet; the coils are 6 feet apart, and consist of 20 pounds of No. 14 copper wire each. The car is 12 feet long, of iron, and weighs about 350 pounds.

This car can be continuously driven around the oval track, and has attained a speed of 45 feet per second. Its greatest acceleration observed has been about 3½ feet per second, which, if maintained for a minute, would give a speed of about two miles a minute. The shape and difficulties prevent the acquiring of such a speed.

There are numerous details yet to be worked up for its improvement that have been suggested by the performance of the present apparatus—they are chiefly of a mechanical sort—such as the reduction of friction in various places by changing the positions of the wheels and track.

There is no reason now why the apparatus should not be exhibited freely to any who care to inspect it. Its performance reinforces the judgment formerly expressed, that the Portelectric system will attain great commercial importance.

A. E. DOLBEAR,
Electrician N. E. P. Co.

Boston, Sept. 28, 1890.

Platinum.

Five years ago, platinum was seldom used in this country, being employed only in the evaporating stills for the concentration of sulphuric acid and in the manufacture of jewelry. It was then to be bought in the market for $3 and $5 an ounce. A year ago it advanced to $8 an ounce, six months ago it had increased to $14, and it has now gone up to $20, which is only a few cents less than gold quotation.

Magnetic Circuits.

BY H. E. J. G. DU BOIS.

A considerable extension of our knowledge of magnetic induction has lately taken place. This, like many other additions to the realm of science, was chiefly called for in order to meet the wants of designers of electric machinery; and it has accordingly been arrived at in an essentially practical way. The aim of this preliminary communication is to show how physical science may draw advantage from some of these results, and may obtain them by unobjectionable purely physical methods. In doing so, I shall not

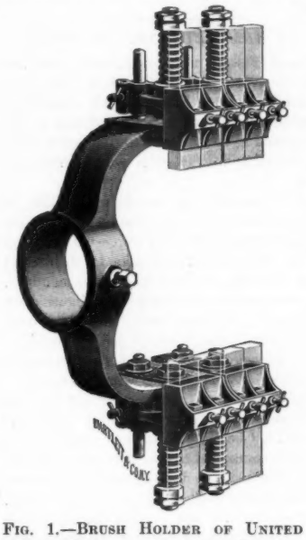


FIG. 1.—BRUSH HOLDER OF UNITED STATES DYNAMO. (SEE FIRST PAGE.)

so much use the conception of lines of force, but shall rather start from the consideration of magnetization. For it is the latter quantity which, for experimental reasons (*Phil. Mag.* [5] xxix, p. 303, 1890), I believe, must be taken as the fundamental one from the physical standpoint, much more so than induction, to which such importance has lately been attached.

The idea of an analogy (even when only in mathematical treatment) of magnetic systems with other systems of fluxes (hydrokinetic, thermal, electric) dates back as far as Euler. Faraday (and following him, Maxwell) and Sir W. Thomson then each developed it in his own way. It has been worked out and practically applied, however, during the last decennium.

Bosanquet (1883), Rowland (1884), W. v. Siemens (1884), Gisbert Kapp (1885), especially consider the analogy with the flow of electricity, and, accordingly, apply Ohm's law to magnetic circuits. As, however, this law essentially implies the resistance being constant, independent of the current flowing, the above extension of its most characteristic meaning can hardly be conceded from a physical point of view; nothing is thereby meant to be said against certain practical advantages gained by introducing a (essentially variable) magnetic resistance. Quite lately, again, Pisati (1890) has laid much stress upon the analogy with thermal circuits, and, accordingly, has applied Fourier's law to certain magnetic systems. This appears, perhaps, less objectionable, in so far as thermal conductivity is not necessarily a constant, as its electric analogue is, though Fourier originally introduced the former as such. But even then it depends upon temperature, not upon its space variation or upon the flow of heat; the analogy is, therefore, in no case a complete one, magnetic conductivity being, of course, independent of magnetic potential.

No physical objection, however, appears to exist to the totally different treatment the question received at the hands of J. and E. Hopkinson (1886). They started from two safely established mathematical propositions, and only made some auxiliary assumptions in order to simplify the (approximate) calculations. In this way they so arrived at their graphic construction, now used, to a certain extent, in machine design, and which will be reverted to below.

Poisson's old theory of magnetic induction, extended by Neumann and Sir W. Thomson, as laid down *e.g.* in Maxwell's treatise, is known to rest on the fundamental assumption of constant susceptibility; it, therefore, applies to all substances except "ferro-magnetics" (iron, cobalt, nickel, magnetite and any substance which may yet be found to behave similarly). Kirchoff then introduced a new theory (in 1853) by making the more general assumption that magnetization is a function (capable of experimental determination) of the total magnetic intensity. Besides the important solutions of certain particular cases (ellipsoid, closed ring), he restricted himself to giving a few integral equations in the place of Poisson's. However, these were of but little practical use, and are hardly more so now, that Duhem has lately taken up the analytical problem anew.

A more geometrical treatment of the new theory showed the distributions of the vectors concerned to be as follows: (*a*) magnetic intensity, lamellar; (*b*) magnetization, complex-lamellar; (*c*) induction, solenoidal; (*d*) also the three vectors are easily seen to have the same direction at every point. The proof and further discussion of these propositions cannot be given here. It may be remarked that homogeneous, isotropic ferromagnetic substance is assumed, through which no electric currents are supposed to flow; neither is hysteresis taken into account.

The simple type of a circuit not completely closed is a thin ring containing a radial air gap and subjected to a uniform tangential magnetizing force. This particular case, a solution of which has to my knowledge never been attempted, is reducible to the known case of an ellipsoid of revolution. In fact, it is only necessary that the "self-demagnetizing factor" be capable of calculation; *i. e.*, the number into which the magnetization has to be multiplied in order to obtain the intensity of the self-demagnetizing effect. Let this numerical factor be, as usual, denoted by N; for sufficiently long ovoids (prolate ellipsoids of revolution) of axial ratio, m, it is found by the well-known equation

$$N = \frac{4\pi}{m^2}(\log_e 2m - 1).$$

Now let the gap of our ring have the angular value a; *i. e.*, an arbitrary concentric circle in it being considered, the $a/360$ part of this will lie in air, the $(360 - a)/360$ part in the ferromagnetic substance. A consideration of the line integral of the self-demagnetizing intensity, which must vanish along any such closed circular line of integration, leads as a first approximation to the result that

$$N = \frac{4\pi a}{360 - a} \quad [\text{approx.} \doteq .035\, a].$$

The proof cannot well be given without a diagram. Both particular cases are now comparable in every respect, as the following short table shows:

Ovoid. m.	Factor. N.	Ring. a
		°
20	.0848	2.41
30	.0432	1.22
40	.0266	.76
50	.0181	.52
100	.0054	.15
8	0	0

Now, Lord Rayleigh has given a graphic construction for ovoids, which Ewing expresses in the following words: From the ordinary curve of magnetization for infinitely long ovoids, that corresponding to a given finite one may be obtained by shearing the diagram parallel to the axis of abscissæ through an angle, which is simply determined by N, therefore, also by the given ratio of axes. By the above, the curve for closed rings may now, in the same way, be sheared into a diagram for a ring with a given angular gap.

The analogy of this process with the Hopkinsons' well-known graphic method is obvious, though at first essential differences appear to exist; *e. g.*, the quantities used for co-ordinates are not the same in both cases. However, a comparison in detail finally leads to the identification of both constructions, so that in any given particular case the curves would exactly overlap, supposing the co-ordinates to be measured to proper scales. Our problem, a solution of which was first necessitated and afterwards approximately given by machine practice, has, therefore, now been solved to the same order of approximation by physical methods.

The degree of this approximation, the allowable limits for thickness of ring and width of air gap, the amount of "leaking" of lines of force, etc., can only be determined by experiment on as large a scale as possible.

Thunderstorm Observations.

In a paper recently communicated to the Hungarian Academy, M. Hegfroky gives the results of a study of five years' thunderstorms (1882–6) on the Hungarian plain. Days on which thunder was observed formed 16.4 per cent. of all days from April to September. Nearly half of the season's rainfall was on days of thunderstorm. Hail fell on 11 days, on one of which there was no thunderstorm. There were most thunderstorms in June (59 out of 199). The June of 1886 had as many as 26. The commencement of a thunderstorm occurred most often from 2 to 5 P. M. The author accepts Sohncke's theory that the electricity of thunderstorms is due to friction of water-drops on ice.

Carey, O.—The Buckeye Fuel and Light Company; capital, 200,000.

Indianapolis, Ind.—The Indiana Telegraph Company; capital, $100,000.

Pittsburgh, Pa.—The Hughes & Gawthrope Electric Company; capital, $25,000.

Eau Claire, Wis.—Eau Claire Street Railway, Light and Power Company; capital, $100,000.

Chicago, Ill.—South End Electric Railway Company; capital, $100,000; incorporators, F. R. Dyche, C. J. Wood and C. E. Lost.

Keokuk, Ia.—Gate City Electric Company; capital, $150,000. Incorporators, G. D. Rand, J. L. Root, W. W. McCoy and C. R. Fellows.

Alton, Ill.—The Alton Consolidated Electric Railway Company, to construct street railways; capital, $200,000. Incorporators, C. H. Holmes, William S. Rogers and Joseph Morrison.

Portland, Me.—The International Beacon Vacuum Pump and Electrical Company; capital, $500,000. Officers, Jacob Heilborn, of Boston, president; and Lewis E. Whicher, of Boston, treasurer.

Astoria, Ore.—The Electric Power and Transit Company, of Astoria; capital, $150,000. J. M. Moore, president; A. P. Sharpstein, manager, and C. E. Belding, secretary and treasurer.

Alexandria, Va.—Hubbell Electric Light and Power Company; capital, $100,000. Officers are I. Saks, president; George Moss, treasurer, and E. Sutherland, secretary, all of Washington, D. C.

New York City.—The Aerial Conduit Company, Limited; capital, $35,000. Incorporators, John F. Gibley, Frank W. Rennell, New York city; and James Craig, Fred. H. Smith, Austin Gallagher, Brooklyn.

Newark, N. J.—The American Type Telegraph Company; capital, $600,000. Incorporators, Horace P. Hussey, Cleveland; Wm. Henry Smith, Chicago; Joseph G. Siebeneck and Robert H. Campe, Pittsburgh, and John E. Wright, New York.

Chartiers, Pa.—The Chartiers Valley Light and Power Company; capital, $30,000. Directors, Samuel A. Duncan, Pittsburgh; William J. Langfitt, Allegheny; William M. Galbraith, Chartiers; Edward G. Hensler, Mansfield; Joseph A. Langfitt, Wilkinsburg.

Pueblo, Col.—The Jenkins Electric Mining Machine Company; capital, $100,000. Incorporators, J. B. Oram, C. L. Wall, J. N. Carlile, Charles Henkel, Fred. Rohrer, H. Pollard, G. W. Gill, J. A. Thatcher, W. W. Strait, T. A. Sloane, J. J. Stanchfield and W. P. Hobson.

Niagara Falls, N. Y.—Niagara Falls and Lewiston Railroad Company; capital, $100,000. The directors of the company are, John M. Brinker, Murray A. Verner, Daniel O'Day, Robert W. Jones, Charles R. Huntley, C. D. R. Stowits, Frank M. Brinker, B. L. Jones, all of Buffalo, and H. S. McKee, Morris S. Verner, J. K. Verner, Thomas McKee and William Jones, of Pittsburgh.

Electricity is being brought more and more into intimate connection with photography. It is now used in lighting studios, and for securing artistic effects of light and shade in the subject to be photographed. In order to avoid dark, hard shadows, the light is projected onto a sheet of alabaster, and from this is refracted onto the subject. The result is soft and exquisite in tone.

ELECTRICAL REVIEW

Published at 13 Park Row,
P. O. Box 3329. NEW YORK.

EDITORS:
GEO. WORTHINGTON. CHAS. W. PRICE.

ASSOCIATE EDITORS:
ROBT. H. READ. STEPHEN L. COLES.

BUSINESS STAFF:
GEO. WORTHINGTON, President. CHAS. W. PRICE, Secretary.
ROBT. H. READ, Manager Patent Bureau.
H. T. RICHARDS, Mgr. Advertising Department.

BOSTON OFFICE:
W. I. BARKER, Room 29, 620 Atlantic Ave.

WASHINGTON OFFICE:
GEO. C. MAYNARD, 1409 New York Ave.

CHICAGO OFFICE:
D. B. DEAN, 163 Randolph Street.

EUROPEAN OFFICE:
CHARLES FFRENCH, Bridge House, 181 Queen Victoria St., London, E. C.

REGISTERED CABLE ADDRESS:
"ELECTVIEW," NEW YORK.

"1546 CORTLANDT," TELEPHONE CALL.

SUBSCRIPTION TO THE
ELECTRICAL REVIEW.

One Year, United States and Canada, - $3.00
One Year, Foreign Countries, - - 5.00
Single Copy, - - - - .10

ANNOUNCEMENT.

Address all communications and make all money orders and checks payable to order of ELECTRICAL REVIEW, P. O. Box 3329, New York.

No attention will be paid to communications for the REVIEW without the *name and address of the writer.*

NEW YORK, NOV. 1, 1890.

CONTENTS.

PAGE.
The Eickemeyer Street Car Motor ... 113
A New United States Dynamo ... 113
All Watches Compasses ... 113
History of Electric Lighting ... 113
Frankfort Exhibition ... 113
Galvanic Current Generated by Muscular Action ... 113
The Civilian Electrician in Modern War ... 114
New England Portelectric Company ... 115
Platinum ... 115
Magnetic Circuits ... 115
Thunderstorm Observations ... 115
New Corporations ... 115
An Army Electrical Corps ... 116
"Electric Rock" ... 116
The Claims of Our Mayor and the Board of Electrical Control ... 116
Book Notices ... 116
Correspondence:
Our Boston Letter ... 117
Our Chicago Letter ... 117
Personal ... 117
A New Atlantic Cable ... 117
Liquid Resistances in Rheostats ... 117
Perrett Motor Installations ... 117
General Electrical Notes ... 117
Telephonic News ... 118
The Extent of the Excursion of the Electrodes of a Microphone Transmitter ... 118
Telegraphic ... 119
Electric Power ... 120
The Electric Railway in Greensburg, Pa ... 120
Bradley's Alternating Current Motor ... 120
The Short Railway Generator ... 121
Electric Light News ... 121
Electric Clubs:
New York Electric Club ... 122
Harvard Electric Club ... 122
Electric Welding Applied to the Manufacture of Projectiles ... 122
The Franklin Fund ... 123
Big Damages for Failure to Deliver a Telegram. 123
Beats Vivisection ... 123
Some Recent Electrical Patents ... 123
Kindred Interests ... 124
Alexander, Barney & Chapin ... 124
A District Beer Call System ... 124
Financial ... 124
Electrical Patents ... 124

INDEX OF ADVERTISERS.

COVER PAGES.

PAGE.
Alexander, Barney & Chapin ... ii
Ansonia Brass & Copper Co ... xxiv
Armington & Sims ... xxiv
Bridgeport Brass Co ... xxiv
Brush Electric Co ... xxiii
Davis, Charles H., Electrical Engineer ... xxiv
Day's Kerite Insulated Wires ... xxiv
Eastern Electric Cable Co ... xxiv
Hampson & Co., E. P ... xxiv
Jewell Belting Co ... xxiv
Moore, Alfred F ... xxiv
Okonite Co ... xxiv
Simplex Electrical Co ... xxiv
Standard Underground Cable Co ... xxiv
Tucker Electrical Construction Co ... xxiv
Wilmot & Hobbs Manufacturing Co., The ... xxiv

INSIDE PAGES.

Accumulator Co., The ... vi
American Bell Telephone Co ... xiv
American Circular Loom Co ... xx
American Electrical Works ... xiii
Baker & Co ... xiii
Ball Electric Light Co ... xiv
Barnes Co., W. F. & John ... viii
Baxter, H. E. & C ... xxi
Bernstein Electric Co ... xv
Brownlee & Co ... xvi
Buckeye Engine Co ... viii
Burton Electric Co ... xiv
Bunnell & Co., J. H ... 124
Cary & Moen ... xxi
"C. & C." Electric Motor Co ... xvi
Central Electric Co ... xi
Chadbourne, Hazelton & Co ... xviii
Clark Electric Co ... x
Consolidated Electric Storage Co., The ... viii
Crocker-Wheeler Motor Co ... vii
Crosby Electric Co ... xii
Dwight Slate Machine Co ... xxi
Eastern Plaster Board Co ... xiii
Edison General Electric Co ... iii
Edison Manufacturing Co ... ix
Eddy Electric Mfg. Co ... xix
Electric City Co., The ... xvii
Electric Merchandise Co ... xvi
Elektron Manufacturing Co ... xx
Empire China Works ... xiv
Empire City Electric Co ... xxii
Eugene F. Phillips Electrical Works, Ltd ... xiii
Eureka Tempered Copper Co ... vii
Evans Friction Cone Co ... xiv
Faraday Carbon Co ... xxi
Field Engineering Co ... x
Fletcher & Fletcher Electric Co ... 124
Fort Wayne Electric Co ... xxii
Garvin Machine Co ... viii
Gate City Electric Co ... xi
Gordon & Co., W. H ... xiii
Great Western Electric Supply Co ... vi
Greeley & Co., The E. S ... x & xiii
Heine Safety Boiler Co ... xviii
Hill, Warren S ... x
Holmes, Booth & Haydens ... xx
Holtzer-Cabot Electric Co ... xviii
Indurated Fibre Pipe Co ... xx
Industries ... vi
International Aluminum Works ... x
Interior Conduit & Insulation Co ... xvi
Laird & Lee ... xxi
Lane & Bodley Co ... xxi
Law Telephone Co ... 124
Leclanche Battery Co ... xiii
Leffel & Co., James ... xxi
Lehigh Valley Creosoting Co ... xiii
Macfarlane & Co., Wm ... xiii
Maguire, F. Z ... 124
Marshall, Wm ... xiii
McCreary Electrical Specialty Co ... x
Messner, C. W ... 124
Nassau Electrical Co ... xv
National Carbon Co ... vii
National Electric Mfg. Co ... ix
Newark Machine Tool Works ... xiii
New England Butt Co ... viii
New York Belting and Packing Co ... xxi
Noye Mfg. Co., John T ... viii
Otis Bros. & Co ... xiii
Ostrander & Co., W. R ... xiii
Paillard Non-Magnetic Watch Co ... xxi
Parker-Russell Mining and Manufacturing Co. xxi
Phœnix Glass Co ... xiii
Phosphor-Bronze Smelting Co., Ltd ... viii
Pond Engineering Co ... viii
Queen & Co., James W ... xiii
Roebling's Sons Co., John A ... vii
Royce & Mareau ... xxi
Sawyer-Man Electric Co ... xv
Schieren & Co., Chas. A ... 124
Schuyler Electric Co ... xviii
Shultz Belting Co ... x
Southern Electrical Supply Co ... xx
Standard Electric Supply Co ... x
Stanley & Hall ... v & xvi
Stevens & Babcock ... vi
Swift Manufacturing Co., H. E ... vii
Tropical American Telephone Co ... x
Thomson-Houston Electric Co ... iv
United Electric Traction Co ... xi
United States Electric Lighting Co ... xvii
Universal Arc Lamp Co ... xviii
Vincent & Co., Charles R ... viii
Wainwright Mfg. Co ... xxii
Walker Electric Co ... viii
Washburn & Moen Manufacturing Co ... xxi
Watson & Stillman ... xiii
Western Electric Co ... xxi
Western Power Construction Co ... xvi
Whipple Co., F. H ... vii
White, R. T ... vii
Williams & Potter ... viii
Writing Telegraph Co ... 124
Wyckoff Pipe Co ... xiii

In this issue will be found a highly interesting article on the extent of the excursion of the electrodes of a telephone transmitter, by Professor Charles R. Cross. Some very minute measurements are dealt with in Professor Cross' usual masterly way, and the facts he sets forth are worthy the attention of every telephone man.

The weather is cooling off but the electric fan still finds an occupation; if not in supplying cooling breezes, then in exhausting vitiated air from ill-ventilated rooms, and causing a current of fresh, pure air to take its place. It is just now, when doors and windows are closed up, that the necessity for good ventilation becomes keenly felt, and no better ventilator exists than the electric fan.

It is to be hoped that the changes now being made on the New York approach to the Brooklyn bridge will result in a decided improvement. This end of the bridge has always been an eye-sore—a disgrace to New York. A roomy, well-lighted, comprehensive structure should be erected—an edifice that in appearance and stability would harmonize with the great bridge. Electric light should be used for attractive and striking illumination.

One of the numerous applications of the electric welding process is clearly described by Lieutenant Wood in his article on the welding of projectiles. The advantages obtained by electrically welding projectiles are sufficiently great to effect the immediate and universal adoption of the process.

The central station manager now looks with dismay at his rapidly diminishing coal-pile and wonders if it will last the Winter through. The days are getting shorter and the lighting service proportionately longer. This takes coal to make steam, to make power, to make light. Coal is a good thing, and light is a better one. See that you have coal!

AN ARMY ELECTRICAL CORPS.

Lieut. Fiske's suggestion, made in a lecture delivered before the New York Electrical Society, published in full elsewhere, that an electrical corps be established in the army and navy to look after the application of electricity in warfare is worth consideration.

A few months ago we drew attention in this column to the organization of the New York Naval Militia, and suggested that electrical men might, profitably to themselves and that body, enroll themselves as members, thus in a degree returning the obligation the electrical profession owes the navy from which many able workers have transferred their energies to the broad field of electrical engineering. It would seem, however, a good plan to detail some of the officers and men now in the service to such work. It would not be difficult to find electrical engineers competent to take care of such matters if occasion should require their services, so far as the technical features are concerned, but if civilians are pressed hurriedly into action their lack of military training might prove a serious embarrassment, so that a much higher degree of efficiency would be attained by having such a corps equipped with men skilled in the tactics of warfare. It would be a profitable and instructive way for some of the officers now on the pay rolls to beguile the many leisure hours between pay days.

"ELECTRIC ROCK."

Truly is electricity the science of wonderful surprises. The latest discovery is reported from Syracuse, near where a deposit of solidified electricity has been found. This remarkable ore, which is called "electric rock," is said to contain a "hidden force that puzzles and astonishes all who see it, and expert electricians in particular." The last sentence is a trifle incongruous, because we should think that "expert electricians" ought to be the last persons to be puzzled and astonished by such a trifle as electric rock. The properties claimed for this new material by its discoverer, however, are certainly calculated to astonish and puzzle even inexpert electricians. It will generate unlimited power and give any amount of incandescent light, equal, if not superior, to that produced by *manufactured* electricity, in addition to which it is cheaper than kerosene. One small charge of 400 pounds of rock will produce light and power for one year before losing its force, and it is perfectly harmless, making insulation entirely unnecessary. These puzzling and astonishing claims are so broad and extensive, that we can only conjecture that the birthplace of lightning must have been discovered at last.

One of the experiments made by the discoverer, causes us to be just a trifle skeptical of the whole business. We read that a piece of the rock weighing half a pound was placed in a pint tumbler and the wires attached to a call bell "which it caused to ring as loud as an alarm clock."

We scarcely think that a gentleman who is in the habit of using *pint* tumblers can be depended upon to make great discoveries, although, of course, that would depend a great deal upon the usual contents of the pint tumblers. In any case, the whole story looks uncommonly like one of the scientific fairy tales so frequently served up by the daily press.

THE CLAIMS OF OUR MAYOR AND THE BOARD OF ELECTRICAL CONTROL.

It was scarcely to be expected that Mayor Grant would have the audacity to take credit for the so-called management of subway matters during his term as president of the Board of Electrical Control. Yet, in a leaflet published by the political body of which he is so conspicuous an ornament, intended for the conversion of voters in the coming city elections, we find a paragraph referring in glowing terms of praise to his policy of bluster and blunder with the electric wires. We learn that "when Mayor Grant took office there was not a single foot of electric light wire underground, and the city was disfigured by an overhanging net of dangerous wires. In 18 months, against the bitter opposition of the electric light companies, Mayor Grant put 813 miles of light and power wires underground. He also forced the telegraph and telephone companies to place 17,090 miles of wire underground, against only 4,200 miles under Mayors Grace and Hewitt. Since he took office, 7,399 poles and 10,674 miles of wire have been put underground." It seems a curious idea to put 7,399 poles underground, and one scarcely likely to lead to any good result, but that is only a minor point. The ludicrous part of this boasting and exaggerated effusion is, that Mayor Grant should pose as a public benefactor in regard to city electrical matters, when, as a matter of fact, he has shown himself throughout utterly incapable of dealing with scientific questions in an intelligent manner, and by his childish exhibitions of temper and ill-breeding, has made almost every meeting of the Board of Electrical Control a scene of confusion and impotent wrangling. The figures given by the Mayor's political backers merely show the natural growth of the underground system in New York, a growth that has gone on in spite of the blundering policy of the Board of Electrical Control; a policy, if such a continued exhibition of incapacity can be called a policy, which has made the name of that distinguished body a by-word in electrical circles throughout the country.

BOOK NOTICES.

St. Nicholas has completed 17 successful years, and begins its 18th with the November number.

A new work of practical value, entitled "Electricity in Daily Life," is about to be published by the Scribners. It is a popular account of the application of electricity to every day uses. The various branches of the work have been entrusted to writers selected for their expert acquaintance with the subject The volume contains 120 illustrations.

"The Upper Ten," by Wm. H. Ballou, has been received. It ridicules New York society in its generous welcome of foreign titles in preference to Americans, and has the hero—one of the 400—rescue his sweetheart, an actress, from the deepest point in the Atlantic ocean, where she had been sunk in a steel-bound chest by the lover's father, who desires his son to marry a title. The actress, who had become queen of a mermaid colony, was found through the medium of a submarine vessel, manned by her devoted one, with a *scientific shark* as her captain, brought back to New York and received with open arms by society, because, forsooth, she had been a queen and possessed several bags of pearls gathered from the bottom of the ocean. The long-distance telephone is described at length, with considerable accuracy; and this new submarine vessel, in itself a wonder, is at all times telephonically connected by means of fine copper wire and the present submarine cables with New York city. The author has placed few restrictions on his imagination, and has interwoven an impossible tale with original scientific ideas that are at once striking and interesting, some of which are not improbable.

Four hundred new subscribers were placed on the books of the ELECTRICAL REVIEW last week. Additional names come with every mail. The people of this globe seem to know a good thing, and appreciate it to-day more than ever.

CORRESPONDENCE.

OUR BOSTON LETTER.

The Thomson-Houston Works, at Lynn, Mass., will be inspected by the British Steel and Iron Institute Committee during the coming week.

Lieut. W. M. Wood, of the Thomson Electric Welding Company, read a paper on "Electric Welding Applied to the Manufacture of Projectiles," before the Society of Arts, last Thursday evening, at the Massachusetts Institute of Technology.

The Beacon Vacuum Pump is attracting the attention and awakening considerable interest among the incandescent lamp manufacturing companies of this section. This meritorious apparatus is manufactured by the Beacon Vacuum Pump and Electrical Company; offices No. 15 High street, this city.

Mr. John Tregoning, ex-superintendent of the Electric Welding Works at Lynn, Mass., recently sailed for Europe where he will establish, it is said, a branch factory for the Thomson Electric Welding Company in some city in England.

Messrs. Kendall & Slade, the well-known wiring and construction firm, this city, are selling a novel and meritorious device for use in connection with an electric motor in blowing church organs. One of the useful devices has been successfully working for some time on an organ at the Masonic Temple, Chelsea, Mass.

Boston Electrician Burned.—Advices from Great Barrington, Mass., under date of October 20th, state that Mr. D. A. Murphy, a Boston electrician engaged in moving an electric light plant at Kellogg Terrace, the home of E. F. Searles, was badly burned about the face, this afternoon, by the explosion of an alcohol lamp, used by him in soldering a wire. The skin was torn from the greater portion of his face and his eyebrows and moustache were burned off.

A New Electric Conduit has been undergoing experimental treatment during the past month by the electric railway experts at the Thomson-Houston factory, Lynn, Mass., and it is reported that for streets having first class drainage this conduit will be especially suited for electric railways. At the present time the company and its employés are reticent in giving information regarding the new conduit. It is said that the company has invited some Washington, D. C., railway officials to visit the factory and inspect the conduit.

The Electric Mutual Insurance Company, of this city, has already written risks on electric light stations and other property upward of $3,000,000, and the company's agents are sending in new business by nearly every mail. President S. E. Barton has his hands full looking after the office correspondence, while Chief-Inspector Capt. Wm. Brophy is busy writing risks in Northern New York. Capt. Brophy's son, one of the most active of the company's agents, is contributing liberally to the prosperity of the enterprise he represents by the large number of electric light stations he has insured during his extensive tour through the Southern States.

American Waltham Watches. — In the Supreme Court recently Judge Holmes issued an order restraining the United States Watch Company from advertising its product as "Waltham watches." The action of the court was upon an application by the American Waltham Watch Company, which alleged that its competitor was endeavoring to deceive the public in representing that the watches they sold were "Waltham watches," whereas the only watches which can legally be sold under that name are those made by the plaintiff.

The Chapman Valve Company are erecting a new building at the northern end of their old machine shop at Indian Orchard, Mass. It will be of brick, 120x50, and three stories in height. The building will be ready for occupancy before December 1st, and when filled with its complement of machinery, will increase the output of the company about 30 per cent. Business for 1890 is reported as being considerably ahead of the same time in 1889.

Electric Light Companies Consolidate.—An authentic report comes from Rockland, Conn., to the effect that the trouble between the Rockland Electric Light Company and the Abington and Rockland Electric Light and Power Company has been settled by their consolidation.

Opposition to a Gas Company.—Advices from New Bedford, Mass., dated October 21st, report that the subscribers of stock for the Co-operative Electric Lighting Company, in opposition to the New Bedford Gaslight Company, this evening elected these officers: President, J. M. Lawton, Jr.; vice-president, N. P. Hayes; secretary, A. G. Alley; treasurer, F. R. Hadley; executive committee, H. C. Hathaway, Dr. C. R. Hunt, H. B. Coffin, William Sanders and William R. West. The capital stock is $50,000.

More Electric Cars for Springfield, Mass.—The directors of the Springfield Street Railway Company voted last Monday to call a meeting of stockholders to ask that the capital stock of $400,000 be doubled so as to use electricity on all the lines. The single trolley system has been successfully used one season on the line to Forest Park, that city.

The Thomson Electric Welding Company's factory at Lynn, Mass., may be appropriately termed an electrical bee-hive. From early morn till late hours in the night the large working force is kept busy handling and shipping welding machines. Among the numerous orders filled during this month are the following: The Okonite Company, New York, two machines, making five in all purchased to date; used for welding copper wire, ½-inch to No. 19 A. W. G. The Edison Company, Schenectady, N. Y., three machines for welding copper wire. The Johnson Girder Rail Company, Johnstown, Pa., two additional machines (making three in all), for welding iron and steel.

Boston, October 25th. W. I. B.

OUR CHICAGO LETTER.

The Calumet Electric Street Railway, which extends from the South Chicago Rolling Mills by way of Eighty-ninth street, Mackinon avenue, Harbor avenue, Ninety-third street and Strong Island avenue to Ninety-fifth street, was opened to the public Saturday, the 4th inst. The trial trip was made over the entire line, everything proving entirely satisfactory. This is the first electric line for Chicago, and the success attending it speaks well for the system used, as well as for the prospect of more roads. The Rae system is used on this line, and will also be used on the extension, work on which is being pushed rapidly forward.

The Westinghouse Electric and Manufacturing Company have recently opened their railway offices in the Pullman building (ground floor), and are the proud possessors of as fine a suite of offices as can be found in the West. Mr. J. L. Barkley, who is well known in railway circles, has the management, and is ably assisted by Messrs. Steward, Osgood and Atkinson.

G. A. E. Kohler, Western representative of the Eddy Motor Company, has recently closed a number of large contracts for electric motors; prominent among which is one for Thompson's restaurant, Chicago. This is a 20 horse-power, and will be used to drive an Excelsior arc dynamo.

The United States Dental College have also placed an Eddy motor in their rooms for running a blower.

The Combination Tin Shades designed by George Cutter, of Chicago, are becoming so popular that the Great Western Electric Supply Company have been kept busy filling orders, which reached fully 3,000 last week. The new fixtures put out by this company are meeting with great success, and large orders are received. This company announce some railway novelties which will soon be ready for the market.

The First of the Winter Series of literary meetings of the Chicago Electric Club was held Monday evening, Oct. 20th. A paper by B. E. Sunny on Electric Lighting was read. A business meeting of importance followed the literary programme.

The Great Western Electric Supply Company report continued activity in all departments. Their orders for rail bonds, pole ratchets and curve insulators, are in keeping with the spread of the electric railways, and their new designs of fixtures are beautifying hundreds of homes. They are also supplying the coming generation with learners' telegraph instruments and with experimental apparatus. D. B. D.

Chicago, October 25.

PERSONAL.

Col. J. H. Shay, of the Munson Belting Company, Chicago, has been spending a few days in New York.

Mr. David Chalmers, lately traveling salesman for the Empire City Electric Company, has accepted a similar position with Alexander, Barney & Chapin, 20 Cortlandt street, this city.

Clift Wise, formerly with the Minneapolis Street Railway Company, is now chief engineer of the Interior Conduit and Insulation Company, with headquarters at 16 and 18 Broad street, New York City.

Mr. Chas. W. Hazeltine, of St. Louis, president of the Hazeltine Electric Company, is making New York his headquarters for a few days, a guest of the Hotel Imperial. Mr. Hazeltine is the inventor of the new electric arc lamp which is attracting attention among electric lighting men.

Mr. M. M. M. Slattery, the widely known electric light inventor, of Fort Wayne, Ind., is said to have turned his attention to storage battery development with much success. We shall all await with interest the announcement by Mr. Slattery of what he has accomplished in this branch of electrical work.

A New Atlantic Cable.

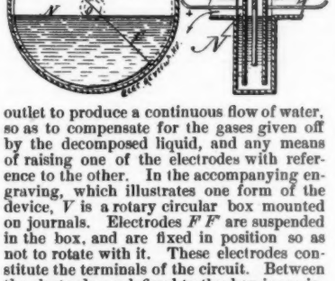
It has just leaked out, says a recent cable dispatch from London, that a meeting of a number of capitalists, headed by C. W. Bonynge, of San Francisco, has taken place, with the object of arranging for the immediate putting into operation of a scheme for the laying of a new cable across the Atlantic Ocean. The undertaking is capitalized thus: £800,000 of stock is to be taken by eight men at £100,000 each, to be fully paid up and no debentures issued. The cable is to be laid from Valentia Bay, on the west coast of Ireland, to a point on the American coast near New York, if possible.

Mr. Bonynge was seen at his home in Princes Gate. He said. "I am one of the people interested, and have paid up £100,000. The cable, however, will be practically a private enterprise, as we shall not go to the public with debentures. We can lay the cable complete and in working order for £800,000, and it will be odd if we cannot pay a big dividend and give the public an immense advantage besides. Further than this I prefer to say nothing." It is thought that the real object of this enterprise is the reduction of cable rates. Those interested say that satisfaction can be given and good service carried on at a rate of three cents a word, and a large dividend paid into the bargain. Mr. Bonynge will sail for New York by the "Teutonic" on the 29th to make the American arrangements.

As part of the plan, it is decided that the company shall build and own its own wires from New York to Chicago, St. Louis, Boston and Philadelphia, and then control absolutely and exclusively the greatest share of all the American business.

Liquid Resistances for Rheostats.

Marcel Deprez, the noted French electrician, has recently patented an improvement in liquid rheostats. Water is ordinarily employed as the resisting material. Metallic plates immersed in the water are caused to move with reference to one another so as to expose more or less surface, and thereby vary the resisting power of the liquid contained between the two substances. The rheostat may consist of an ordinary closed vessel, provided with an inlet and an



outlet to produce a continuous flow of water, so as to compensate for the gases given off by the decomposed liquid, and any means of raising one of the electrodes with reference to the other. In the accompanying engraving, which illustrates one form of the device, *V* is a rotary circular box mounted on journals. Electrodes *F F'* are suspended in the box, and are fixed in position so as not to rotate with it. These electrodes constitute the terminals of the circuit. Between the electrodes and fixed to the box is an insulating partition *C*. When the box is turned, more or less of the insulating partition can be interposed between the electrodes *F F'*, and thereby vary the resistance of the column of liquid between these electrodes.

Perrett Motor Installations.

About a year ago, the proprietor of the St. George Hotel, Brooklyn, contracted with the Elektron Manufacturing Company, of Brooklyn, for a one horse-power Perrett motor to operate a ventilating fan in the hotel. He was so well pleased with the way the motor did its work that he ordered another ¼ horse-power Perrett motor to run a knife-scouring machine. The next order was for a four horse-power Perrett to run the dish-washing apparatus. Finally, a few days ago, a 10 horse power motor, another Perrett, was installed, which now operates all the laundry machinery. The steam engine, which formerly did this work, stands cold and idle. The proprietor likes the motors better than steam engines because they make so much less noise, and he can operate them from the isolated electric light plant which the hotel put in some time ago. The Elektron Manufacturing Company is also furnishing Perrett motors for operating all the machinery in the large new five story factory building at 331-333 Adams street, Brooklyn, occupied by Carroll & Hass, ornamental iron workers. No steam power will be used at all. Perrett motors doing all the work. Current will be furnished by the Edison Illuminating Company.

GENERAL ELECTRICAL NOTES.

By the McKinley bill a duty of 35 per cent. *ad valorem* is imposed on mica.

The Providence, R. I., Tramway Company has been refused permission to lay additional tracks by the board of aldermen.

The Central District and Printing Telegraph Company, of Pittsburgh, Pa., has announced its usual quarterly dividend of three per cent.

It would pay to grant electric street car franchises for a period of 100 years much better than to cling to the mule system for another decade.—*Houston, Tex., Post.*

The Pacific Postal Telegraph Cable Company's telegraph line was formally opened for use between Tacoma and Port Townsend, Wash., on October 15.

The Calumet Electric Street Railway Company, which has been for two weeks successfully operating an electric street car line in South Chicago, has asked for an additional franchise.

The Pacific Postal Telegraph Line, which is now being built between Olympia and Port Townsend, Wash., will be completed shortly. It is said that the rates will be reduced 33⅓ per cent. over the new line.

The annual statement of the Duluth, Minn., Telephone Company, as filed with the State auditor, shows the gross earnings to be $22,690; royalties, $6,258.50; taxable earnings, $16,431.50; tax at two per cent. $328.61.

Philadelphia capitalists propose building an electric street railway in the Bethlehems, and have asked town council for the right of way. A like request also comes from a number of Bethlehem and South Bethlehem capitalists.

Dernberg, Glick & Horner, north-east corner State and Adams streets, Chicago, who last week closed a contract with the Thomson-Houston Company for a 45 arc light plant, have also been equipped with an incandescent outfit. They have also contracted with the Chicago Arc Light and Power Company for arc lights to be suspended over the sidewalks, on both Adams and State streets.

Some interest has been aroused as to the intentions of the telegraph companies in Minneapolis, Minn., in regard to underground wires. Neither the North American nor the Western Union have taken any steps toward placing their wires underground, although the period of grace expires January 1st. The city's telephone, electric light and other wires are rapidly going below the surface of the streets. The telegraph companies are thought to be getting ready to carry the matter into the courts.

New mechanical movements are not often brought forward, but one which may possibly be of use for the gearing of dynamos, for the changing of reciprocating into rotary motion, is the invention of Mr. James Hayton, of Utah. On the rotary shaft is a cogwheel, or, rather, half a cogwheel, gearing, in the first half revolution, to the cogs at the top of a sliding piece, and in the second half to the teeth at the bottom, the result being that a backward and forward movement of the sliding piece rotates the shaft. The device avoids all dead centers, and is designed to transmit power without undue friction or lost motion.

In the case of the Edison Electric Light Company against the United States Electric Lighting Company for infringement of one of the plaintiff's patents, Judge Lacombe recently heard argument on an application of defendants to require the Edison Company to produce certain letters and documents relating to an application made to the Patent Office for a division on the patent involved in the litigation. This evidence was in the possession of one of the lawyers of the Edison Company, who refused to surrender it on the ground that it was a privileged communication, and the officers of the Edison Company refused to aid the defendants. The United States Company failed in an attempt to *mandamus* the Patent Office in order to gain possession of the documents relating to the matter on file in that office, but in these new proceedings Justice Lacombe decides that the company is entitled to an order committing the officers of the Edison Company for contempt in failing to obey the subpœna calling for the production of the papers.

*** Sioux City, Iowa, uses about 700 telephones.

*** Telephonic communication is about to be established between Madrid and the Royal Palace of La Granja, a distance of 100 miles.

*** All of the necessary material for a telephone line on the Congo Railroad was shipped from Belgium by a late steamer. The wires are of phosphor-bronze.

*** The Emperor of Germany has offered to the Emperor of Austria a hearing by telephone of the opera of "Carmen," from his chateau at Rohnstock, distant 200 miles from Berlin.

*** Mr. H. H. Jackson, assistant manager of the Atlanta, Ga., Telephone Exchange, has resigned his position with the telephone company, and accepted a position with the Thomson-Houston Electric Company, under Judge Howard E. W. Palmer, general southern agent.

*** According to *La Lumière Electrique*, a "telephonic bonnet" has just been adopted in the Italian garrison artillery, the idea being that the gun detachment commanders should array themselves in this headgear, so as to be in constant communication with the officer commanding the battery or fort.

*** The Mexican Telephone directors have agreed upon an adjustment of the suit brought against them by their old manager, John Crawford. The suit was brought for $4,000, but the settlement was effected at $1,250. Several of the patent suits have also been compromised on a very satisfactory basis.

*** The telephone cable to be laid across the English Channel will, it is stated, contain four copper conductors, each a strand of seven wires insulated with gutta-percha, and the group will be protected by layers of tanned hemp and an outer sheathing of galvanized iron wires laid on spirally, after the manner of an ordinary submarine telegraph cable. The conductors have been calculated to give good speaking and the armor to guard the wires from ships' anchors or bottom friction.

*** The Tropical American Telephone Company, Boston, have just taken an order for 110,000 feet of Okonite wire for export, and this in competition with a number of large dealers. They have peculiar facilities for supplying export trade with electrical supplies. They are now bidding on three large orders for multiple switchboards to be exported, and, as they can furnish these devices free of United States royalties, they expect to get the contracts. Although long-distance transmitters are not sold here, the Tropical Company can manufacture them abroad and ship directly to South America. The Tropical Company are the sole exporters of Bell and Blake instruments to South America, and are doing a very large business.

*** The statement of the output of telephones by the American Bell Company for the month ended Oct. 20th, is as follows:

October,	1890.	1889.		
Gross output	5,378	5,152	Inc.	226
Returned	2,205	1,781	Inc.	424
Net output	3,173	3,371	Dec.	198
Dec. 21 to Oct. 21.				
Gross output	53,787	48,394	Inc.	5,393
Returned	22,315	19,898	Inc.	2,417
Net output	31,472	28,496	Inc.	2,976

The following is a summary of the telephones now under rental by the Bell Company:

Dec. 20, 1889, there were in licencees' hands, under rental, as per last report	444,861
In the month ended Jan. 20 there were added	1,101
In the month ended Feb. 20	2,037
" " March 20	3,531
" " April 20	4,170
" " May 20	4,803
" " June 20	5,831
" " July 20	1,900
" " Aug. 20	1,561
" " Sept. 20	3,365
" " Oct. 20	3,173
Increase in telephones under rental ten months	31,472
Making the total number Sept. 20, 1890	476,333
Comparing the same time 1889, with	439,030
Increase in telephones under rental	37,297

The Extent of the Excursion of the Electrodes of a Microphone Transmitter.

BY PROF. CHARLES R. CROSS, OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

The character and extent of the motions of the electrodes of a microphone transmitter, when actuated by sound-waves of different degrees of intensity, is a subject in telephony of by no means slight importance, but to which very little study has been given. The present paper describes the results of some observations relating to this subject, which have been made at various times during the past two years.

Several years ago an attempt was made by Mr. W. W. Jacques and the writer to gain some knowledge as to the amplitude of the vibrations of the hammer electrode of a microphone, by observing it with a microscope while in operation, and noting the extent of the blurred portion of the image. The results, though giving all that could be expected from so crude a method, were not very satisfactory so far as definite measurement was concerned.

It afterwards occurred to the writer that the matter might be studied more completely by the use of the stroboscopic method, and an arrangement of apparatus was adopted by which the motions of the electrodes could readily be observed.

This was done in the following manner: The microphone to be studied was placed in the field of a microscope, whose line of collimation was horizontal. Behind the microphone, at a suitable distance, was placed a Helmholtz mercury interrupter, with a tuning-fork making 128 vibrations per second. The extra current due to the electro-magnets of the interrupter was quite large, so that a brilliant spark was obtained at each rupture of the circuit, as the platinum style of the interrupter left the mercury. The interrupter being properly placed, and the light of the spark concentrated by a lens, quiet a bright field was obtained, against which the electrodes were seen projected, as silhouettes. The light, though intermittent, of course, seemed continuous, since the sparks were so numerous. When good definition was obtained, the microphone was set in operation, usually by means of an organ-pipe placed at a convenient and variable distance, and in some experiments by the voice. The pipe was blown by a constant blast, and great uniformity of intensity in the sound was secured. An open C_5 organ-pipe making approximately 256 double vibrations per second was commonly used, its pitch being variable to a moderate extent by shading the mouth or the opening at the top.

So long as the pipe was an exact octave in pitch above the interrupting fork, the electrodes of the microphone, as seen with the microscope, appeared to be at rest; but if the interval was slightly disturbed, the stroboscopic effect was observed, and the electrodes seemed to move slowly through their complete course. The rate of this apparent vibration was of course dependent upon the deviation of the pipe from exactness in its interval with the fork, and could be varied at will within quite wide limits.

The extent of the motion of the electrodes could be determined by observing the grains of dust which adhered to them, or some definitely marked roughness on their surface. Measurements were made by means of a spider-line micrometer, the wires of which were placed at a convenient distance apart, and the amplitude of the motions of the selected points of reference on the microphone was determined by estimating the relation of their apparent motion to the distance separating the wires of the micrometer. This last distance was frequently varied to diminish the liability to error from a possible bias of the observer towards an agreement with earlier results.

In the experiments described in the present paper, the electrodes were generally so adjusted that the motion of the anvil electrode was too small to be observed. Under these circumstances, the observed motion of the hammer electrode, as measured by the micrometer, was the motion of this relatively to the anvil electrode, which is, of course, the quantity to be determined, rather than the actual excursion of the hammer electrode.

The microphone was placed in circuit with a battery and the primary of an induction coil, whose secondary contained a receiving telephone. With this arrangement, the effect on the ear of the electrical variations due to the various values of the excursions of the electrodes could readily be observed. In many cases, a second observer was stationed at the receiving telephone, which was then placed in a separate room.

Magnifying powers were used of from 50 to 1,000 diameters. With the higher powers the use of an objective of short focal length was difficult on account of the small working distance, so that, although even as short a focus as $\frac{1}{16}$ inch was sometimes employed, it was found much preferable to obtain the needed magnification by the use of short focus eye pieces.

The brilliancy of the electric spark was amply sufficient for illumination of the field, even with the highest magnification employed; a fact which calls attention vividly to the enormous "instantaneous intensity" (so to call it) of that light. Considering the excessively brief duration of the spark and the very small quantity of matter illuminated, it seems unquestionable that the intrinsic brilliancy is far greater than that of the electric arc, a view fully supported by the results of the spectroscopic study.

Various forms of microphone were observed, but the general features characterizing the actions studied were common to them all. As the intensity of the sound acting on the microphone was increased by approaching the organ pipe to the diaphragm, the motion of the hammer electrode, at first absolutely invisible, was seen gradually to increase, until, when the intensity was very great, the motion was excessive, the anvil electrode being violently pushed aside, and the hammer leaving it on its return motion, so that the circuit was broken at every vibration. At the same time bright sparks were seen between the electrodes. To the ear the simultaneous acoustic changes in the sound transmitted were very striking. The sound of the pipe was distinctly audible and its quality clear, with motions of the hammer electrode far too slight to be observable. As the sound actuating the telephone became louder, and the excursion of the electrode became visible, the quality continued good, the sound transmitted growing louder; and then, as the excursion increased further, the quality gradually changed, shrill false notes made their appearance, and the sound began to grow harsher, until finally, when breaks appeared in the current, the sound was excessively harsh and entirely devoid of musical quality. Long before this, however, the characteristic quality of the organ pipe disappeared.

The following tables will illustrate the results obtained. In making many of the measurements, I worked in company with Mr. W. W. Jacques, whose observations were always in substantial accord with my own. A large number of observations have also been made, under my direction, by Messrs. A. W. Jones and F. L. Dame, students in the Laboratory, whose work has been performed with conscientiousness and accuracy.

The microphone used in most of the experiments was one in which the anvil electrode was a "pendulum electrode," suspended by a vertical rod, hinged at the top, and so weighted as to give to it a proper mass. The desired normal pressure could be obtained by sliding the point of suspension laterally so as slightly to incline the supporting rod, and further, by adding a weight so as to exert a proper leverage, if this was desired. The hammer electrode was pointed and carried by the diaphragm, which was of mica. The sounding pipe was gradually removed from, or approached toward, the microphone. Care was in all cases taken to keep the wind pressure constant. A single Leclanche cell was ordinarily used, though in a few cases a Grenet cell was employed.

In the various tables, the excursions of the electrodes are in all cases given in fractions of an inch. In designating the material of the electrodes, that of the anvil is stated first.

Tables I to III show the results obtained when both electrodes were of carbon; tables IV and V, when the anvil electrode was of carbon, the hammer of platinum. Tables VI to VIII contain results of observations made with a modified form of transmitter, in which the anvil electrode was also somewhat heavier than in the earlier experiments.

TABLE I.

ELECTRODES, CARBON, CARBON.—*Magnification*, 50 *diameters.*

Excursion.	Character of Sound.
1000×10^{-6} to 700×10^{-6}	Constant breaking and sparks. Electrodes visibly separating.
600×10^{-6}	Constant sparking. Electrodes occasionally seen to separate.
200×10^{-6}	Occasional breaks and sparks.
200×10^{-6}	Scratchy sound, no sparks.
No visible motion.	Sound clear and smooth.

TABLE II.

ELECTRODES, CARBON, CARBON.—*Magnification*, 50 *diameters.*

Excursion.	Character of Sound.
1000×10^{-6} to 600×10^{-6}	Constant sparks; electrodes separating.
300×10^{-6} to 200×10^{-6}	Harsh; occasional breaks and sparks.
150×10^{-6}	Scratchy.
No visible motion.	Clear and smooth.

Whenever the excursion of the hammer was greater than 100×10^{-6} the sound was very scratchy and harsh.

TABLE III.

ELECTRODES, CARBON, CARBON.—*Magnification*, 160 *diameters.*

Excursion.	Character of Sound.
350×10^{-6} to 300×10^{-6}	Loud, noisy, harsh.
250×10^{-6} to 200×10^{-6}	Very scratchy.
120×10^{-6} to 80×10^{-6}	Scratchy, but less than before.
150×10^{-6} to 100×10^{-6}	Scratchy, but with high overtones.

At the lowest amplitude given in Table III the quality of the sound of the pipe was first heard, but a still less amplitude was necessary for its satisfactory reproduction.

TABLE IV.

ELECTRODES, CARBON, PLATINUM.—*Magnification*, 160 *diameters.*

Excursion.	Character of Sound.
250×10^{-6}	Constant sparks and breaks.
120×10^{-6}	Scratchy; occasional sparks and breaks.
70×10^{-6}	Raspy.
50×10^{-6}	Quality distinct, but high squealing overtones present.
20×10^{-6}	Quality better; fewer high overtones.
Less than 20×10^{-6}	Quality better; some high overtones still audible.

The pipe had to be carried twice as far away from the transmitter as in last measurement, to a distance of 18 inches, before the quality became really excellent.

TABLE V.

ELECTRODES, CARBON, PLATINUM.—*Magnification*, 150 *diameters.*

Excursion.	Character of Sound.
120×10^{-6}	Very scratchy; occasional sparks.
60×10^{-6}	Squealing; high overtones.
40×10^{-6}	Fair quality; high overtones prominent.
$< 20\times10^{-6}$	Good quality; a little rough.
400×10^{-6}	Constant breaking.
60×10^{-6}	Very raspy.
40×10^{-6}	High overtones strong.
20×10^{-6}	Quality good.

TABLE VI.

ELECTRODES, CARBON, PLATINUM.—*Magnification*, 700 *diameters.*

Excursion.	Character of Sound.
200×10^{-6}	Rough, but pitch discernible.
80×10^{-6}	Rough, pitch distinct.
30×10^{-6}	Smooth, with high overtones.
30×10^{-6}	" " "
20×10^{-6}	Quality good; some high overtones.
10×10^{-6}	Good quality.
25×10^{-6}	Smooth, with high overtones.
30×10^{-6} to 40×10^{-6}	High overtones prominent.
80×10^{-6}	Harsh and rough.

TABLE VII.

ELECTRODES, CARBON, PLATINUM.—*Magnification*, 940 *diameters.*

Excursion.	Character of Sound.
1000×10^{-6} to 800×10^{-6}	Scratchy, with breaks.
100×10^{-6}	Rough, with high overtones.
80×10^{-6}	Wheezy, " "
40×10^{-6}	Smooth, " "
30×10^{-6}	" " "
60×10^{-6}	Rough, " "
50×10^{-6}	Harsh, " "
40×10^{-6}	Smoother.
30×10^{-6}	Smoother, with high overtones.
20×10^{-6} to 30×10^{-6}	Good quality, high overtones present.
20×10^{6}	Good quality.

TABLE VIII.

ELECTRODES, CARBON, PLATINUM.—*Magnification*, 940 *diameters.*

Excursion.	Character of Sound.
1000×10^{-6}	Harsh and screamy.
2000×10^{-6}	" "
1000×10^{-6}	High overtones heard; no distinct pitch transmitted.
400×10^{-6}	High strident overtones present.
100×10^{-6}	High overtones still present.
60×10^{-6}	Sound wheezy.
30×10^{-6}	Sound smooth.
20×10^{-6} to 10×10^{-6}	Quality good.

The differences in the effects obtained with a microphone in which both electrodes are of carbon, as compared with one in which one of the electrodes is of platinum, are well known to every one who has considered the subject. While with the latter it is more easy to produce an actual break of contact between the electrodes than with the former when the sound is increased, on

the other hand, the quality is much more satisfactorily reproduced, and does not so rapidly disappear on increasing the loudness. These differences were clearly noticed in the observations. Thus, for slight excursions of the hammer electrode, the quality of the sound with two carbon electrodes was found to be less satisfactory than when the hammer was of platinum, although in the latter case the point of actual breaking of circuit and sparking was usually reached with a less excursion than in the former one. Evidence of these differences appears in the tables just given, and also in those which follow.

It must be observed, that, while the figures given in the tables show what is the maximum amplitude of vibration of the electrodes consistent with the transmission of quality, they entirely fail to indicate the excessive minuteness of the least excursions which are capable of this result. How minute these sometimes are may be inferred from the following observation:

With a microphone having a somewhat heavy anvil electrode, the organ pipe was gradually moved away from the diaphragm, and the diminishing range of motion of the electrodes noted in the usual manner. When the pipe was at a distance of three inches, the motion of the electrodes was too slight to be visible, although this could have been seen readily with the low magnifying power employed if it had been as great as $\frac{1}{10000}$ in. The pipe, still blown with the same loudness, was then carried farther and farther away. At a distance of 36 feet, which was the most distant point from the microphone in the room, the sound of the pipe was still distinctly, though faintly, audible at the receiver placed in circuit with the microphone and in a distant apartment.

The results shown in the preceding tables give an idea of the phenomena observable with a microphone of the structure employed. Inasmuch as the primary object of the measurements was to obtain some idea of the actual value of the excursion of the electrode, the mass and normal pressure of the electrodes were not particularly considered, except that they were so adjusted as to give good transmission with moderate loudness of the sound actuating the microphone. But it would, of course, be expected that the numerical value of the relative excursion of the electrodes corresponding to any given character of sound would vary with the mass of the anvil electrode and with the normal pressure between the electrodes. Two separate sets of observations were made to observe the effects of such variations by Messrs. Jones and Dame. The latter series was somewhat more complete than the former, besides being carried on with better instrumental appliances, and the results hereafter given are taken chiefly from it.

In all experiments of the nature of those under consideration, it is very difficult to get any fixed standard of quality to which to refer such results as the present. Different observers differ to a certain extent in their estimate of the excellence of the quality reproduced. But the point at which the distinctive quality of the transmitted sound disappears is quite well marked, and a very slightly increased vibration of the hammer electrode causes great harshness to result. For this reason, the name "critical point," originally suggested by Mr. Jones, has been given to this limit, and the excursion corresponding to it has been particularly noted in tests of the varying effects of mass and pressure.

The transmitter used had its anvil electrode suspended like a pendulum, as before. In order to vary the mass without varying the normal pressure, a horizontal wire was suspended beneath the anvil electrode and rigidly attached to it. The middle point of the wire was vertically beneath the point of suspension of the electrode. The masses added consisted of small copper washers weighing 1.1 grams each. By adding two of these whenever the mass was to be increased, and placing one on each side of the middle point of the horizontal wire, the mass of the electrode was increased, while the normal pressure remained substantially constant. In the experiments whose results are contained in Tables IX to XIII, the normal pressure was exceedingly small, the electrodes always being kept in very light contact. This condition of things was easily secured by a slight adjustment of the position of the washers. A magnification of 280 diameters was usually employed.

The following results were obtained by the mode of procedure just described:

TABLE IX.

ELECTRODES, CARBON, PLATINUM.

Mass in Grams.	Excursion of Hammer at Critical Point.
4.0	12×10^{-6}
8.1	25×10^{-6}
10.3	37×10^{-6}
12.5	50×10^{-6}
14.7	50×10^{-6}
17.0	50×10^{-6}
19.2	50×10^{-6}
21.4	50×10^{-6}

TABLE X.

ELECTRODES, CARBON, PLATINUM.

Mass in Grams.	Excursion of Hammer at Critical Point.
4.8	12×10^{-6}
5.9	25×10^{-6}
8.1	37×10^{-6}
10.3	37×10^{-6}
12.5	50×10^{-6}
14.7	50×10^{-6}
17.0	50×10^{-6}
19.2	50×10^{-6}
21.4	50×10^{-6}
25.8	50×10^{-6}
4.5	12×10^{-6}
8.7	25×10^{-6}
10.9	37×10^{-6}
13.1	50×10^{-6}
17.5	50×10^{-6}
21.9	50×10^{-6}

TABLE XI.

ELECTRODES, CARBON, CARBON.

Mass in Grams.	Excursion of Hammer at Critical Point.
8.5	18×10^{-6}
10.7	18×10^{-6}
12.9	25×10^{-6}
15.1	25×10^{-6}
17.3	25×10^{-6}
19.5	37×10^{-6}
21.7	37×10^{-6}
23.9	37×10^{-6}
28.3	37×10^{-6}

TABLE XII.

ELECTRODES, CARBON, CARBON.

Mass in Grams.	Excursion of Hammer at Critical Point.
5.7	12×10^{-6}
8.7	17×10^{-6}
10.9	25×10^{-6}
13.1	37×10^{-6}
15.3	37×10^{-6}
17.5	37×10^{-6}
19.7	37×10^{-6}
5.7	12×10^{-6}
9.1	18×10^{-6}
11.3	37×10^{-6}
15.5	37×10^{-6}
15.7	37×10^{-6}
17.9	37×10^{-6}
20.1	37×10^{-6}

TABLE XIII.

ELECTRODES, PLATINUM, PLATINUM.

Mass in Grams.	Excursion of Hammer at Critical Point.
7.65	12×10^{-6}
9.85	25×10^{-6}
12.05	31×10^{-6}
14.25	37×10^{-6}
16.45	37×10^{-6}
18.65	37×10^{-6}
20.85	37×10^{-6}
7.65	12×10^{-6}
9.85	25×10^{-6}
12.05	37×10^{-6}
14.25	37×10^{-6}
18.65	37×10^{-6}
20.85	37×10^{-6}

An inspection of Tables IX to XIII shows that the value of the excursion of the hammer electrode corresponding to the "critical point," and presumably, therefore, the excursion corresponding to any given degree of excellence in the reproduction of quality, at first rises very rapidly as the mass of the anvil electrode is increased, but soon reaches a maximum value, which is not altered by further increase of mass. The rise appears to be less rapid when both electrodes are of carbon than when one or both of them are of platinum, as may be seen by a comparison of the various tables, or, better still, by plotting the results so as to exhibit them graphically by curves. Also, when both electrodes are of carbon, or both of platinum, the maximum and permanent excursion at the critical point is considerably less than when the hammer electrode is of platinum and the anvil of carbon—a fact which goes to explain the well-known excellence of a microphone employing these last materials. Further experiment is desirable, however, before fully accepting this explanation. Furthermore, variations in the surface and shape of the electrodes are likely to modify these values to a certain extent. Thus the carbon electrodes used by Mr. Jones gave the results shown in Tables XIV and XV. The arrangement of the electrodes was as already described, except that the anvil was slightly inclined, and in the second series a weight of bent wire was added to increase the normal pressure by a small amount.

TABLE XIV.

ELECTRODES, CARBON, CARBON.

Mass in Grams.	Excursion of Hammer at Critical Point.
6.5	36×10^{-6}
8.9	50×10^{-6}
11.3	60×10^{-6}
13.7	60×10^{-6}
16.1	60×10^{-6}
18.5	60×10^{-6}
20.9	60×10^{-6}
23.3	60×10^{-6}
25.7	60×10^{-6}

TABLE XV.

ELECTRODES, CARBON, CARBON.

Mass in Grams.	Excursion of Hammer at Critical Point.
2.9	20×10^{-6}
5.3	30×10^{-6}
7.7	40×10^{-6}
10.1	55×10^{-6}
12.5	60×10^{-6}
14.9	60×10^{-6}
17.3	60×10^{-6}

In connection with the various preceding tables, the following results obtained by Mr. Jones will be of interest.

TABLE XVI.

ELECTRODES, CARBON, PLATINUM.

Series.	Magnification.	Excursion for Good Quality.	Excursion at Critical Point.	Excursion for Breaking.
1	400	16×10^{-6}	60×10^{-6}	80×10^{-6}
2	400	20×10^{-6}	$30-40\times10^{-6}$	60×10^{-6}
3	400	30×10^{-6}	50×10^{-6}	80×10^{-6}
4	350	30×10^{-6}	60×10^{-6}	80×10^{-6}
5	700	40×10^{-6}	60×10^{-6}	80×10^{-6}
6	1000	30×10^{-6}	70×10^{-6}	80×10^{-6}

In Series 2 the normal pressure was slightly less than in the others. The excessively high value of 40×10^{-6} at which in Series 5 good quality still persisted, is the highest that has been observed. The hammer electrode had been brought to a sharp point just previously.

I have observed among the four persons who have employed the method under consideration, that each one has apparently his own standard of what constitutes good quality, and usually adheres quite closely to this in different experiments. The observer last cited generally gave somewhat larger values to the excursion for a given degree of excellence of transmission than I noted in my own observations, apparently from this cause.

A further series of measurements was made in order to ascertain what effect was produced by a variation in the normal pressure between the electrodes.

In order to do this, a wire was caused to project backward from the anvil electrode, and small weights were hung upon the end of it. The pendulum electrode with this projecting wire constituted a bent lever, whose arms were easily measured, thus enabling the normal pressure due to a given weight to be calculated. It was thus obtained very easily, although the method is subject to the objection that there is a certain variation of the mass of the anvil electrode simultaneously with the variation in pressure. The use of a delicate spring instead of the weight would be preferable, but I have not yet found time to carry through observations by this method. The results reached are shown in Tables XVII to XIX.

TABLE XVII.

ELECTRODES, PLATINUM, PLATINUM.

Normal Pressure in Grams.	Excursion of Hammer at Critical Point.
0.34	8×10^{-6}
0.77	14×10^{-6}
1.20	25×10^{-6}
1.63	37×10^{-6}
2.06	50×10^{-6}
2.50	61×10^{-6}
0.34	10×10^{-6}
0.77	12×10^{-6}
1.20	25×10^{-6}
1.63	37×10^{-6}
2.06	50×10^{-6}
2.50	61×10^{-6}
2.93	61×10^{-6}

TABLE XVIII.

ELECTRODES, CARBON, CARBON.

Normal Pressure in Grams.	Excursion of Hammer at Critical Point.
0.297	8×10^{-6}
0.632	12×10^{-6}
0.990	12×10^{-6}
1.288	12×10^{-6}
1.650	25×10^{-6}
2.150	25×10^{-6}
0.272	8×10^{-6}
0.616	25×10^{-6}
0.960	37×10^{-6}
1.304	37×10^{-6}
1.648	37×10^{-6}
1.990	37×10^{-6}

TABLE XIX.

ELECTRODES, CARBON, PLATINUM.

Normal Pressure in Grams.	Excursion of Hammer at Critical point.
0.184	8×10^{-6}
0.288	12×10^{-6}
0.432	12×10^{-6}
0.632	12×10^{-6}
0.990	12×10^{-6}
1.288	12×10^{-6}
1.654	Anvil vibrating.
0.104	$>8\times10^{-6}$
0.132	$>8\times10^{-6}$
0.153	8×10^{-6}
0.184	8×10^{-6}
0.288	12×10^{-6}
0.632	12×10^{-6}
0.990	12×10^{-6}
0.180	8×10^{-6}
0.395	12×10^{-6}
0.620	12×10^{-6}
0.644	12×10^{-6}
0.149	8×10^{-6}

(Continued on foot of last column.)

TELEGRAPHIC

.... The Postal Telegraph Company has succeeded in running a line of poles for its new line from New York to Buffalo through Rochester, in spite of the objections of the city authorities. The poles are placed along the bank of the Erie Canal on the State property.

... To find out the amount of slack given to cables as deposited in the ocean at the time of paying out, Messrs. Siemens Brothers, of London, are using a steel piano wire, payed out simultaneously, with a tension sufficient to make it taut over sea-bottom. By mechanism on board, which measures the rate of paying out cable and wire, the necessary slackness in the cable can be determined and constantly verified, thus avoiding all unnecessary slackness, and saving large sums of money.

.... Mr. McMichaels, superintendent of the Western Union Telegraph Company at Minneapolis, has offered the city some good suggestions about the distribution of wires on poles. The comparison of space occupied is as follows: 160 naked wires would require 65 foot poles, with 20 eight pin cross-arms 10 feet long. The space in front of buildings occupied by this number of wires would be about 10 by 35 feet. The same number of wires could be placed in eight 20-wire cables, which would occupy a space only three by four feet, the cables to be strung 30 feet above the street.

It appears from these results, that the value of the excursion corresponding to the critical point rises with increase of normal pressure, soon attaining a maximum and constant value. The pressure at which this maximum value was reached was greatest when both electrodes were of platinum, and least when the hammer electrode was of platinum and the anvil of carbon. When both electrodes were of carbon, the value lay between these two extremes. The unexpected result was also reached that the value of the maximum excursion was much greater when both electrodes were of platinum than when both were of carbon. It was least when the hammer was of platinum and the anvil of carbon.

A series of observations was also made upon the microphone of the Blake transmitter. These presented considerable difficulty on account of the construction of the parts of that instrument, and only a low magnification could be used. Three sets of measurements were taken, the first with a very light normal pressure, the second with the ordinary pressure, and the third with a very heavy pressure. With this microphone in its proper condition, both electrodes moved. It was, therefore, necessary to subtract the excursion of the anvil electrode from that of the hammer, in order to obtain their relative motion. The results reached are given in Table XX. The total excursion of the hammer electrode, and its motion relative to the anvil, are given as nearly as they could be measured.

TABLE XX.

BLAKE TRANSMITTER—ELECTRODES, CARBON, PLATINUM.

Total Excursion.	Relative Excursion.	Character of Sound.
	a. *Light Normal Pressure.*	
	$<25\times10^{-6}$	Good quality, very faint.
50×10^{-6}	25×10^{-6}	Good quality, clear.
100×10^{-6}	50×10^{-6}	Overtones strong.
	b. *Medium Normal Pressure.*	
	$<25\times10^{-6}$	Good quality, very faint.
75×10^{-6}	25×10^{-6}	Good quality, clear.
100×10^{-6}	50×10^{-6}	Overtones strong.
	c. *Heavy Normal Pressure.*	
	$<25\times10^{-6}$	Good quality, very faint.
100×10^{-6}	25×10^{-6}	Good quality, clear.
150×10^{-6}	50×10^{-6}	Overtones strong.

These results, although of only approximate exactness, are interesting, as they show one cause of the excellence of the Blake transmitter in practice, in that the mode of support of the electrodes allows of very considerable variations in the absolute motions of both of them without material change in their relative motions.

* * Long Branch, N. J., is considering several electric railway schemes.

* * An electric railway is said to be in contemplation to run from San Francisco to Baden, Cal.

* * France has ordered a submarine boat, 131 feet long, to be built by the inventor of the "Gymnote."

* * There is some talk of connecting the towns of Rockland and Camden, Me., by an electric railroad.

* * The Squirrel Hill Electric Railroad, Pittsburgh, has been sold to New York parties for $25,000.

* * The first car ever operated in Rochester, N. Y., by electricity was run on the evening of October 18th. The Short overhead system is used.

* * A Boston despatch reports that the gross earnings of the West End Street Railway Company for the year ending September 30, 1890, were $5,680,000, an increase of $430,000.

* * The South Side Electric Railway recently installed by the Equitable Electric Construction Company, of Philadelphia, was opened for traffic on October 9th. Mr. W. A. Stadelman operating the first car.

* * Professor Barrett, the city electrician of Chicago, proposes to remove the steam engines now used to turn the bridges and substitute electricity. He claims by this means that one man can do all the work at each bridge and lessen the expense greatly.

* * Hartford, Conn., is getting ready to have electric transit in place of horse cars, and the project is so far along that the horse railroad company has applied to the common council of the city for permission to erect poles with which to operate the trolley system.

* * The electric road had a large force of men at work recently laying track on Los Angeles street from Commercial to Arcadia. The company discovered that their franchise did not cover this point, and they hurried to get down the track before any obstacles could be put in their way.—*Los Angeles, Cal., Times.*

* * John Dean Benton, the inventor of the famous nickel-in-the-slot machine, died almost in poverty at Providence, R. I., on October 18. Benton was the one who invented the beautiful mechanical models which are now to be seen on every hand. His inventions brought him $300,000, yet he died almost penniless.

* * A press dispatch from Austin, Texas, dated October 15, says: "The city to-day sold $400,000 of the $1,400,000 in bonds issued to construct a dam across the Colorado River and to erect water and electric light works. The contract to build the dam was let to Bernard Corrigan, of Kansas City, for $501,150, and work on it will commence within 15 days. The city is wild with excitement to-night over the sale of the bonds and letting of the contracts."

* * The Chicago City Railway Company have, for some years, been using a Thomson-Houston incandescent dynamo for lighting their power house and offices, near the corner of Twentieth and State streets, with such good economy and satisfaction, that they have decided to adopt the same system for lighting the new power house at the corner of Sixty-first and State streets. It is much to the credit of President Holmes that he has been quick to avail himself of the many advantages afforded by the use of electricity, as indicated by the adoption of it on many of the street railway lines, outside of Chicago, in which he is interested, notably Rock Island, Moline, Davenport and Indianapolis, and also for the purpose of lighting his power houses. He has adopted the Thomson-Houston system in each case.

The Electric Railway in Greensburg, Pa.

The Greensburg and Hempfield Electric Railway Company, of Greensburg, Pa., started last week the operation of their street car line. The road runs from the Pennsylvania Railroad station through the principal streets of the town to Hempfield, a small suburb of Greensburg, a distance of two and a half miles.

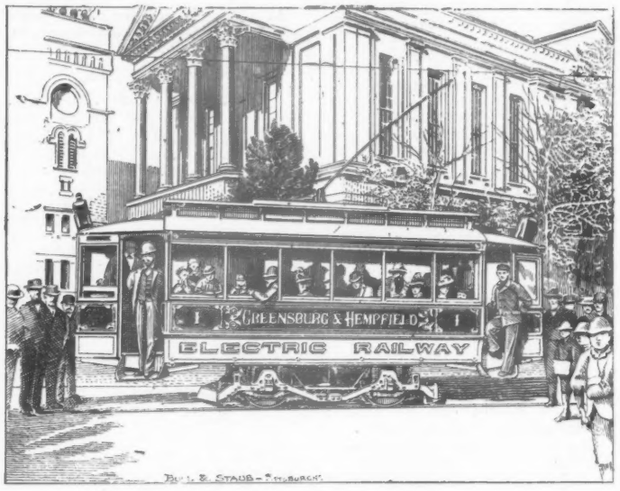


FIG. 1.—THE GREENSBURG ELECTRIC ROAD.

Greensburg had heretofore no street car line of any kind, and the commencement of rapid transit by the electric system was quite an event in the history of the town. All the local papers had made an announcement of the occasion and the hour at which the first car would come along the streets, and the public came out *en masse* to witness the turnout.

The road is operated with the Westinghouse system of electric motors. In covering this distance of two and one-half miles, the cars have to climb no less than eight hills, and the majority of these hills incline at a grade of 10 per cent. In addition to the hills, however, the line is also peculiar on account of the large number of curves, all of them short ones, indeed there are two of a radius of 50 feet. But in spite of all these obstacles to an easy and smooth operation of the motors, it is satisfactory to note that they have given more than excellent service from the moment the first car rolled out of the shed.

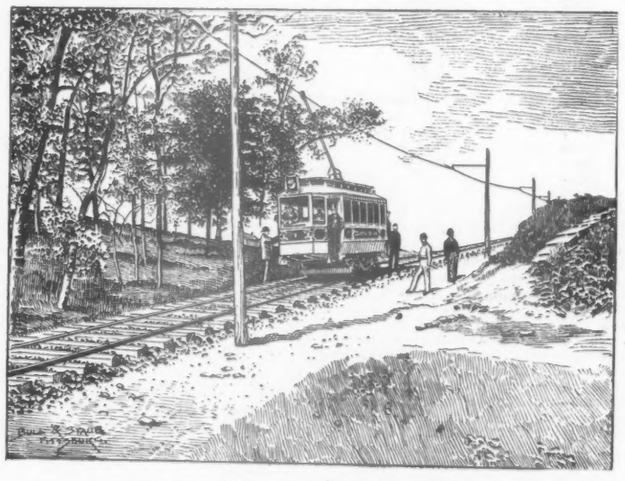


FIG. 2.—ANOTHER VIEW OF SAME ROAD.

Owing to the novelty of rapid transit in Greensburg generally, and of electrically propelled cars in particular, the Greensburg residents have taxed the capacity of the cars to their utmost limit. Every car has hitherto been crowded from the starting point to the terminus and return, the cars having carried on the average, 75 passengers right along.

The track is composed partially of the Johnstown rail and T rail. With the exception of a short distance in the business portion of the town, where the tracks are laid on asphalt covered streets, the road has been stone-ballasted.

The power house is situated near the terminus of the road, at the foot of one of the steepest hills along the entire route. It is very comfortably arranged. The car shed and a repair shop are immediately attached to it, everything being situated level with the ground.

The motors are placed upon Brill trucks, and the body of the car is made by the Chester Car Company. The latter are very commodious and handsomely painted.

Mr. F. Y. Clopper, a well-known Greensburg business man, has charge of the road, and he expressed himself as being in every way satisfied with the equipment of the road, which, he intimated, could not have been better. The North American Construction Company did the construction work on the Greensburg road.

Bradley's Alternating Current Motor.

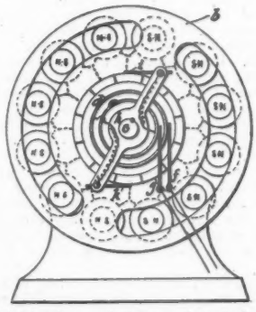
We present herewith illustrations of a new alternating current motor invented by Chas. S. Bradley, a well-known electrical engineer. This motor is particularly designed for application and use on single current circuits.

If we take a disk *b* having two circumferential slots, as in Figs. 1 and 2 of the engraving, and set it so that each slot surrounds or threads the lines of force from alternate fields of force by the pole-pieces A and B, the disk becomes the seat of induced or secondary currents when the field magnets are energized by an alternating current, the paths of such currents being approximately indicated by small arrows on the disk, which constitutes two closed circuits. If the disk be placed in the relation shown in Fig. 1, as soon as the alternating current is admitted to the field A B, the rise and fall of potential therein sets up induced currents, and motion of the disk results from the following principles: All the lines of force momentarily produced during one phase of alternation of magnetism in the field poles cause momentary induced currents, as indicated by the arrows. These currents pass from the center to rim, and rim to center, of the disk at the two unslotted portions shown, being from center to rim at one and from rim to center at the other at the same instant, and therefore the currents generated by A and by B have common directions through such unslotted portions, and are, therefore, attracted, one by the nearest part of field A and the other by the nearest part of field B, and as these attractions take place at opposite sides of the shaft or center, motion of the disk necessarily results. This motion continues in one direction till the disk is about in the position shown at Fig. 2. Motion then ceases because the closed circuits of the disk are equally attracted by the oppositely induced field magnets, which neutralize each other. The principal of invention is thus established, and continuous rotation of an element can be effected by subdividing and angularly displacing or commutating the field magnets.

In its simplest form, the motive device consists of the field magnet A, B, and the slotted disk *b*, as in Figs. 1 and 2.

In Fig. 3, which shows an organized motor, the disk *b* is fixed on a shaft *c* provided with suitable bearings. On this shaft are the two insulated rings, *d*, *e*, on which bear the respective brushes *f*, *g*, continuously. The shaft has fixed to it the brush-arm *h*, which, in turn, carries at diametrically opposite points the insulated brushes *i*, *k*. These brushes bear on a stationary segmental collector or commutator C, having its blocks looped in successively to the subdivided field circuit so as to shift the polar line of the latter accordingly. The field magnet is composed of a group of cores arranged in a circular series, each provided with its own coil, and the pole-pieces facing the path of the semi-circular slot in the disk *b*. There are two series of such field magnets facing each other, and so wound that at any instant

Fig. 3.



at which a given pole has north polarity the pole-piece opposite it on the other side of the disk has south polarity, and so on, so that the lines of force pass directly from the pole-piece of one series to the pole-piece of the opposite series of field magnets. The entire annular series of field magnets have their coils connected in series similarly to the connections of a Grammering. Consequently, at any given moment, all the field poles on one side of the vertical line will have one polarity and all those on the other side the opposite polarity. Thus, in Fig. 3, the neutral line will be a vertical line drawn through the figure, and this line will be the line of commutation and correspond with the operating position of the brushes *i k*. The disk *b* being already advanced a little towards the right, so as to correspond with Fig. 1, immediately takes up motion due to the preponderating attraction, as already explained, and this motion continues with a powerful torque until the brushes have reached the next segment of the commutator, whereupon the neutral line is immediately shifted to the right and the position of maximum torque is again obtained, causing a further attraction of the disk *b* in the same direction, and the corresponding movement of the brushes *i k* repeats this indefinitely as the disk rotates, owing to the described commutation of the field magnets, so as to keep the position of maximum torque continuously ahead of the actual position of the disk.

Fig. 2.

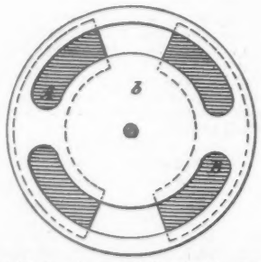
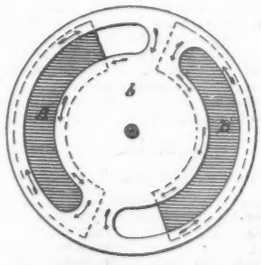


Fig 1



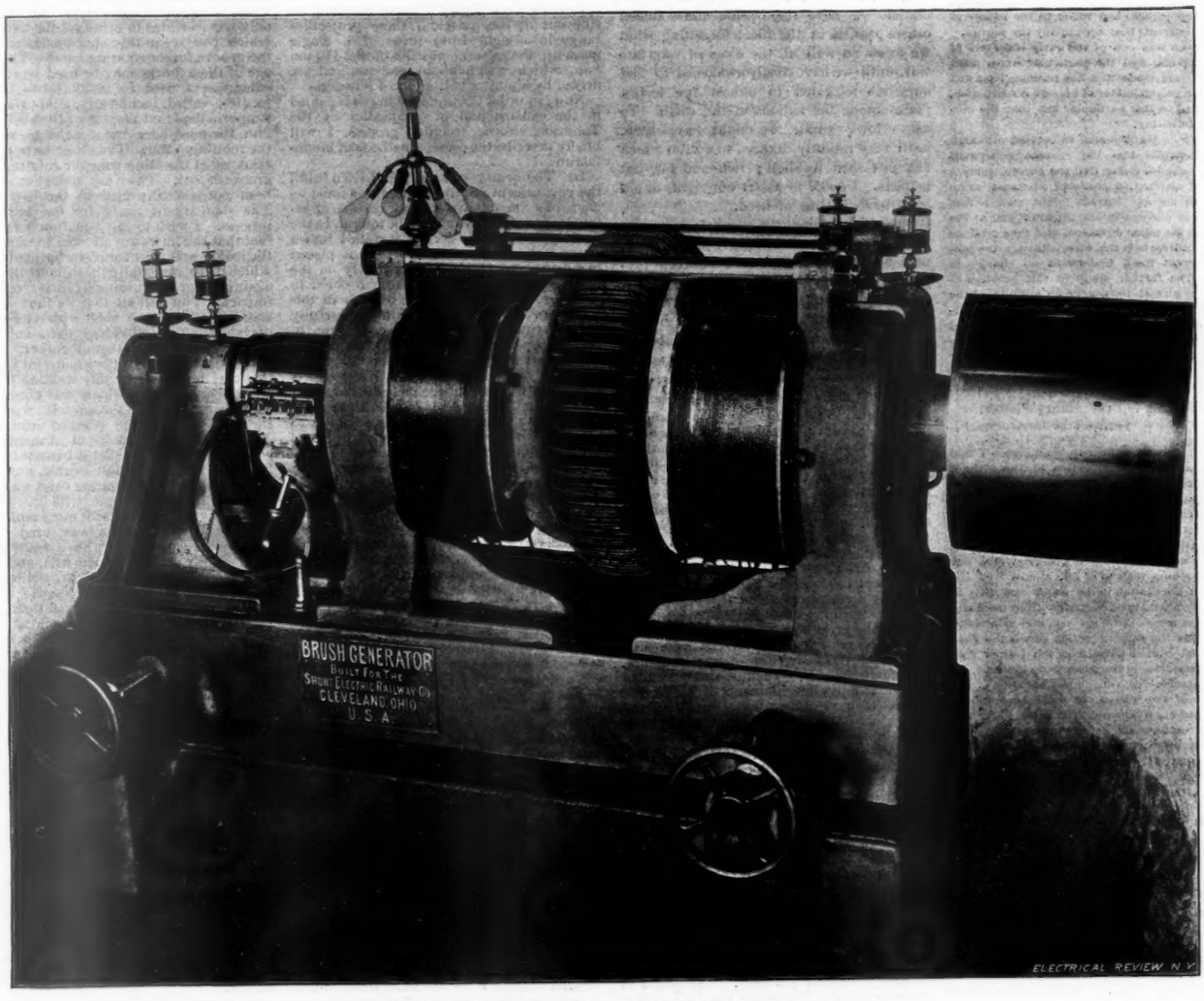
The Short Railway Generator.

A new type of the Short Electric Railway Company's generator is shown in the accompanying illustration. This one is 120 horse-power, but they are made all the way from 50 to 500 horse-power capacity. The larger machines have eight field magnets and the armature runs at a very low speed. They are arranged to run with belts or they may be connected directly to the driving engine, without belts or pulleys of any kind.

The armature of the Short Electric Railway Company's generator for street railway work is similar to that of their motors. It is constructed principally of thin band iron, wound upon an iron form or ring, which constitutes the core of the armature. When completed, the core or ring is milled or slotted. The wire is then wound in these slots, forming the bobbins. The bobbins, after being wound, are connected to the commutator bars or segments. The armature when completely wound contains 96 bobbins and is 26 inches in diameter, the commutator having 48 segments.

The generator itself contains four field magnets which are slightly compound wound. The generator, when completed and ready for service, is mounted upon a very neat and substantial bed-plate, and is provided with adjustable belt tighteners for tightening and loosening the belt and securing perfect alignment. The armature of the Short company's generator, as well as their motors, differs very greatly from those of the drum type, which are so commonly used. Generators in use in Muskegon, Pittsburgh, Cincinnati, Johnstown and other places where the Short company have roads in operation, are doing their work quietly and without trouble of any kind. These machines have made a place for themselves as clearly defined as that of old and standard steam engines. They show immense reserve power, doing excessive work with the same ease and quiet that are their marked characteristics under ordinary load.

The distinguishing characteristics of the Short generator are briefly these: A ring form of armature of large diameter is used, which admits of a low running speed and prevents the hot bearings due to high speed; the large diameter of armature makes it possible to wind each bobbin in a slot by itself, preventing the accumulation of heat, which causes the burning out of the bobbin; the pole pieces of the magnets are presented at the side of the armature instead of at its rim, making binding wires unnecessary, and preventing the bobbins being thrown out by centrifugal force; field magnets are compound wound, ensuring perfect regulation of the generator; carbon brushes are used and the commutator is large, indestructible and absolutely sparkless; no shifting of brushes is necessary under variations in load.



New Generator of the Short Electric Railway Company.

— Austin, Tex., has voted $1,400,000 for water works and electric lights.

— The Westinghouse alternating current arc light system is now being introduced in Norwich, N. Y.

— The Cohoes, N. Y., Gas Company is to put in a new Westinghouse dynamo in their electric light station.

— One of the electric lighting companies in Paris has introduced a traveling testing room or ambulance laboratory for use when repairing cables. The van is fitted with a battery and testing instruments, including a photometer, and is large enough to hold two persons. The plan has been in use since April, and is found to work well.

— The incandescent electric light system has been introduced into the penitentiary at Kingston, Ont. There are 912 lights ranging from 10 to 32 candle-power. Other penal institutions in Canada will be similarly lighted.

— It is expected that the new city electric light plant on Fourteenth street, Chicago, will be in operation between November 1st and 15th. This will give light to a large district which has, heretofore, been in deepest darkness.

— In a power plant installed at the Bremen Exposition of Arts and Industries, 15 horse-power is transmitted a distance of 250 metres. The generator is a Westinghouse machine, yielding 220 volts and 60 amperes, which is connected by an overhead wire, 20 millimetres in diameter, with the motors.

ELECTRIC LIGHT NEWS

— The electric lighting of Berlin has progressed very much during the past few years. In March, 1888, there were 189 private installations, as well as a number of central stations. In 1889 these private plants had increased to 237, of which 79 were run by gas, the rest being driven by steam. The arc lamps used in public buildings numbered 826 in 1889, and in private establishments, 2,976. The incandescent lamps in use numbered 62,816.

— The East St. Louis Packing and Provision Company are making arrangements to put 450 incandescent lights in their abattoir at the stock yards.

— The ferry boat "Climax," of Martin's Ferry, Ohio, is to be equipped with electric lights. It will be the only ferry boat on the Ohio, between Pittsburgh and Cincinnati, lighted with electricity.

— A well-known Pittsburgh insurance agent is reported as saying that the placing of electric lights in breweries would enable the latter to secure much cheaper insurance than formerly. The reason given for this was that with the improvements recently made in electric lighting it was much safer than either artificial or natural gas for lighting purposes, and allowance will be made for it by many of the insurance companies.

— Last month the Illinois Steel Company ordered of the Western Isolated Lighting Department of the Thomson-Houston Electric Company, a 30 arc light plant for their works at South Chicago. They have, during the past week, placed another order for a 35 arc light plant to be installed at the same place. This plant was delivered and set up ready for operation the day following that upon which the order was given. From this, it would appear that, even though the Thomson-Houston Company do an enormous business, they manage to take care of it in a manner that tends to disprove the old adage that "large bodies move slowly." The day may be not far distant when a man can drop into an electric light company's office in the forenoon, place his order, and find, upon his arrival at home in the evening, that the wiring is finished and lights ready to turn on to furnish illumination for his dinner table.

ELECTRIC CLUBS.

AN INTERESTING LETTER SENT TO THE NEW YORK CLUB.—NEW MEMBERS ELECTED, ETC.

New York Electric Club.

The Museum Committee of this Club recently received from Vice-President W. D. Sargent the letter which appears below. In forwarding the letter to the President of the Club, Mr. J. J. Carty, of the Museum Committee, accompanied it with the following letter:

GEN. O. E. MADDEN,
President of The Electric Club.

DEAR SIR: On behalf of the Museum Committee, I send you with this report a letter of Joseph Henry, written to W. D. Sargent from the Smithsonian Institution, November 11th, 1870.

This letter is of considerable historic value, and of particular interest to the Electric Club, as it is written to one who is now one of our honored vice-presidents.

The contents of the letter are of considerable scientific importance, and relate to the nature of the electric currents that accompany the aurora.

Mr. Sargent was one of the early observers of auroral currents, and the particular experiment referred to was made on a line running East and West, with a galvanometer of his own construction, which showed on this particular line that the current was alternating.

Prof. Henry's point seems to be that although on this particular line the current underwent reversals, it did not follow that the auroral current itself was of alternating character; because, as he showed, the auroral current might pass across such a line at one end in one direction and at the other end in the other direction, and thus produce alternating currents in the wire, although the producing current itself underwent no change in polarity. The further study of this question at this date is almost impossible on account of the stray currents from electric light and power circuits which find their way into all telephone and telegraph wires, and which would tend to confuse the observations and to interfere with galvanometer readings.

Yours truly,
J. J. CARTY.

The following is Prof. Henry's letter:

SMITHSONIAN INSTITUTION,
November 11, 1870.

DEAR SIR: On my return to Washington I find your interesting communication of the 27th of September relative to the aurora, and embrace the first opportunity to dictate a reply.

The alternation of the direction of the current I consider a very interesting fact, and one which would be still more important in relation to the theory of the aurora, were it observed in a line North and South, instead of one almost East and West. The alternation in the latter case may be produced by a stream of electricity from the North passing first across the West end, and afterwards another from the same direction across the East, which would cause a current in the former case from the West, and in the latter from the East.

If it be possible for you, on the occasion of the recurrence of the aurora, to make observations with the same galvanometer on a line North and South, the results would be very interesting.

I am, very respectfully, your obedient servant,

W. D. SARGENT, Telegraph Operator, Harrisburg, Pa.
JOSEPH HENRY, Sec. Smith. Inst.

Among Newly Elected Members of the Club are Benjamin Rhodes, of Niagara Falls, N. Y.; F. W. Roebling, Trenton, N. J.; R. R. Appleton, Brooklyn, N. Y.; R. F. Hurcomb, Albany, N. Y.

Several of the Clubites were delightfully entertained by Mr. E. E. Bartlett, at his Brooklyn home, one evening last week.

Out-of-Town Visitors at the Club were numerous last week. Among them were D. B. Dean and J. H. Shay, of Chicago; J. G. Slonecker, Topeka; T. W. Sprague, Boston.

Harvard Electric Club.

The Opening Meeting of the present college year was held October 15th. Seven new members were elected, and two important amendments to the constitution submitted. Three new papers have been added to the Club's library, one of them the *Elektrotechnische Zeitschrift*. These bring the number of papers taken by the Club up to nine; eight weeklies and one monthly. The college carpenter is putting in some book shelves for the bound volumes of the papers, etc. The Club is planning to have six public lectures this season.

At a Meeting of the Electrical Engineering Society, of Lehigh University, the following officers were elected: President, J. S. Lockwood; vice-president, M. N. Usina; secretary, F. A. Merrick; treasurer, J. B. Buckley, all of the senior class.

Electric Welding Applied to the Manufacture of Projectiles.

BY LIEUTENANT WOOD, U. S. N., BEFORE THE SOCIETY OF ARTS, BOSTON.

I am asked to-night to tell you something of a new process which has been originated and developed within the past year; a new and important application of an art in itself new—electric welding.

At this moment, when there is so general an interest manifested throughout the country in the question of the nation's arms and defences, this new invention, which bids fair to supersede and immensely cheapen existing methods, is sure to claim its share of attention, both from experts in ordnance and the general public.

Before entering upon the subject proper, I wish to say a few words on the general state of military art and on the production of projectiles in particular. For nearly a generation we have stood aside and watched others pass us in the race; forgetting what we knew so well at the close of our late war, until we have finally awakened to find ourselves relegated to almost the lowest place among the nations of the earth. To use a lowly simile, we might have been, until very recently, likened to a crab which has just shed its shell; rich and fat, but helpless. Unable to assert our rights or aid our friends in time of need.

Since the earliest times, man's ingenuity has been taxed, first to improve his weapons, next his defences. The race between projectiles and armor commenced with the bow and arrow or sling, as against the rawhide covered buckler. It has passed by gradual evolution through an infinite number of stages; sometimes the armor, sometimes the projectile, ahead; generally the latter. Indeed, at times the projectile has been so much ahead as to cause the total abandonment of armor. This happened when the bullets and slugs from the crude blunderbuss of the middle ages made the matchless armor of the warrior of the day worse than useless. Some authorities are inclined to believe that an analogous case exists now, and that on the sea, at least, it is folly to burden vessels with an enormous weight of armor, which can be pierced so easily by the heavy projectiles thrown by the enormous high powered guns in use. To the casual observer this may seem true, but on the other hand we must not forget that armor *does* protect against the great number of moderate sized projectiles, and that if you can even only partially protect the vitals of your structure, it is much gained. We must also remember that these latest developments of armor and projectile have never been pitted against each other in actual warfare, and that there will be a vast difference between firing through a target at point blank range and at a swiftly moving, rolling, wavering object a mile or more away, which is at the same time firing back at you.

At the present moment it looks as though the projectile was about to gain another point over armor and become a still more important factor. Artillerists on shore are now directing their attention largely to the use of breech-loading rifled howitzers or mortars. These guns are fired at a great elevation, rarely less than 45 degrees, and frequently at 60 degrees. The projectile has, consequently, a high curved trijectory, and plunges down on and through the decks of vessels or behind parapets. The decks of men-of-war are frequently not protected at all, except over the engines, boilers and magazines, where a curved armored deck is used with a maximum thickness of from four inches to six inches. Four inches is the greatest thickness of the curved protective decks of our new cruisers, and is the only armor those now afloat have.

The varying ranges of these howitzer-thrown projectiles are given by increasing or decreasing the weight of the powder charge.

In some recent experiments made by Krupp, in Germany, very satisfactory results have been obtained by projectiles thrown from this class of gun against horizontal targets representing the armored decks of ships.

The defences of Boston and our other seaboard cities are to comprise a large number of guns of this class. They fire both armor-piercing and common shell. Redoubts and turrets on shore can be armored as heavily as you please, or guns and troops can be defended by that most excellent protection, the earthwork. Afloat, however, where every pound carried is a matter of serious consideration, the problem is a very different one, and the weight of armor must necessarily be limited by the size of the vessel. A proper navy, however, will always be made up of a number of vessels of various kinds, more or less dependent on each other; from the gigantic battleship, fully protected by the heaviest armor, down; including the partially protected cruisers, fast unprotected vessels, despatch boats, converted merchantmen, used as commerce destroyers or transports, torpedo boats, etc.

Troops in the field are like the unarmored cruisers, torpedo boats and converted merchantmen, practically unprotected.

For use against these various defences, and when there are no defences except distance and advantage of position, there are in use three general classes of projectiles (not considering the more or less experimental dynamite and other highly explosive shells). They are, 1st, the *armor piercing shell*, used solely, as its name indicates, against heavy armor. 2d, *common shell*, used against unprotected vessels and troops, for bombarding cities and earthworks, for target practice, etc. 3d, shrapnel, so named from its inventor, extensively used in field operations on shore against bodies of troops, and at sea against open boats, torpedo boats or any unprotected body of men.

Leaving the ordinary bullet of the shoulder rifle out of the question, these projectiles range in weight from those of a single pound to the gigantic missiles of the 110-ton gun, which weigh about one ton and are driven by almost a half a ton of powder.

Now, in order to show how much is gained in the construction of projectiles by the Thomson electric welding process, I will briefly describe the present methods of manufacture.

1st. The armor piercing shell. To fulfill the government requirements, these must be made of a fine quality of steel, capable of being made very hard and still be tough. In the first operation it is forged or rolled into a rough, solid blank. After this, it is placed in a lathe and turned off accurately on the outside and the powder chamber bored in the axis of the shell from the base, as in this specimen. This opening is then carefully closed by a carefully fitted screw plug, in the center of which is a smaller threaded hole into which fits the percussion fuse which explodes the shell on impact. A groove is now turned in the outside near the base, and knurled or roughened. This is for the copper rotating band, and the roughening is to prevent its slipping when the copper enters the rifling of the gun. Next the shell is hardened by one of the various processes, which are more or less satisfactory, and, finally, the copper band is forced into place by hammering or hydraulic pressure, and turned off true to gauge. This completes the projectile, and you will readily understand that all of this work is slow, tedious and expensive. Any one who is familiar with the operation of machining high carbon or tool steel, will appreciate this. As a matter of fact, a six inch armor piercing shell, which only weighs 94 pounds, cost in the neighborhood of $65 or $70.

Next come common shell. These at present are cast, either of steel or iron, but even in this cheap form of production many difficulties are met with. In the first place, the shell usually has but one small opening to the inside powder chamber and this only allows the use of a single "print" to hold up the core which forms the interior cavity, consequently, when the molten metal flows in, it pushes this core out of place and the resultant casting is eccentric; thin on one side, thick on the other. Frequently so much so as to cause it to be discarded entirely. When the castings are received from the foundry, they are first carefully calipered on the inside by a skilled operator who uses a delicate instrument called a "star gauge," which expands within and enables him to determine the amount the casting is out of true, which he marks on the shell. It is then passed to the hands of the machinist. He is obliged to place it in his lathe eccentrically so that the outside will be turned true with the inside; and you can imagine that even after all this care they are never perfectly concentric. Another serious difficulty met with in the cast projectiles is the liability to small blow-holes or porosity, which, though they sometimes escape detection, always cause the rejection of the projectile when discovered. Through these holes the gases of the charge might be driven and thus cause a premature explosion of the shell in the gun. Steel shell of this description of six inch calibre cost about $30 each. Like the armor piercing shell, they are fitted with rotating bands and fuses, but are not hardened.

We now come to the shrapnel. It was originally invented for use in the smooth bore guns of the past and was then a hollow sphere filled with small bullets, around which was poured melted sulphur as a matrix. A small powder chamber for a bursting charge was left in the middle. It was provided with a time fuse which could be set so that the shell would explode at the desired moment in its flight, scattering its contents and fragments in the face of the enemy. So far, there seems to have been no very satisfactory shrapnel made for rifle guns. The difficulty is that the head or base has to be screwed on after the body of the shell has been filled with the bullets and matrix. This construction weakens the projectile very much at this point, and the head or base is apt to blow out without bursting the body of the shell or scattering the bullets, especially as the walls of the projectile have to be made thick enough to stand the threading.

Hoping I have now made clear the general state of the art, I will explain wherein this new process differs, and will endeavor to illustrate it by the specimens I have here.

First, instead of the solid rough forged ingot, we have these three component parts, which, when welded together, will form a six-pound armor piercing shell. Each piece is now finished to exact size, except that there is a little extra length to allow for the take-up in welding. The head and base pieces are forged in dies to shape; the central portion is simply a piece cut from a length of solid drawn steel piping. It has all the additional strength due to the fibrous skin inside and out, caused by the drawing process. To join these three pieces, they are clamped into a form of electric welding machine designed for the purpose, and in less than a minute are joined together and made a homogeneous mass like this. It only now remains to grind off the two burrs which you see in this specimen, and cut in the groove for the rotating band. The front one of these burrs may be used to form an enlargement used in many forms of projectiles, called, technically, a bourillet. It supports the front portion of the shell in the gun, the remainder not touching except at the rotating band. The other burr may be removed at the same time the rotating band groove is cut. The fuse hole has already been cut and threaded in the base piece. The shell is now ready for the hardening process. I wish to call attention here to the fact that the burrs are allowed to remain on the inside, and thus form strengthening ribs which help materially to support the shell against the great crushing strain it receives on impact. You will see that we thus formed a stronger and better shell with a minimum of labor on the individual parts and a few seconds work to join them together.

In order to illustrate the wonderful strength that may be gained by this welding process, I have here a shell which was constructed exactly as I have shown. It was fired through a three inch plate of iron at the Naval Proving Grounds, at Annapolis, recently. You will see that it has not changed its shape in the slightest degree, nor has it even lost the copper rotating band which was carried through the hole with it. Here is another, which shows a still more remarkable result. This projectile was fired against heavy steel armor, which has a resistance of about 75 per cent. more than iron, and which was much heavier than a projectile of this size could be expected to perforate. It, however, penetrated five inches, and then, owing to the elasticity of the oak backing of the plate, was then thrown back about 30 feet, as perfect in condition as before it was fired from the gun. The experience of the welding company has been that the metal seems to be strengthened at the point of welding, and this certainly seems to justify the supposition.

After accomplishing results like this, you will see that the manufacture of the common shell becomes a very simple matter. By the welding process, it is quite feasible not only to join iron to high carbon steel, but to weld wrought iron or steel to steel castings, or even to cast iron. Hence, in this case, it is only necessary to substitute common iron or low carbon steel tubing, and stamped or cast heads and bases, and perform the welding operation. The shell which is thus cheaply put together has all the advantages of wrought and none of the disadvantages of cast metal. If made of low steel, it may even be hardened to a certain extent, and thus have more or less efficiency against thin armor.

In regard to the shrapnel, a single look at this section will show the problem and how it has been met. This is from a design for the United States Army 3.2 inch field piece. The head and base are steel castings, which have been heated and compressed to give them density. The body is drawn steel tubing ¼ inch thick. The projectile was built as follows: First, the head was welded onto the body. Next, the brass tube which carries the flame from the fuse to the powder chamber at the base was crimped in at the upper end. The half formed projectile was then inverted and the bullets placed within and the matrix poured about them. Next, the diaphragm which forms the front end of the powder chamber was put into position and the other end of the tube crimped in. The shell is now ready for the final weld, and you will notice that the base piece is provided with a shoulder, which, after the weld is made, will press closely upon the diaphragm and support it against the shock of the discharge. After the second weld is made, the shrapnel has an unbroken surface enclosing its deadly bullets, and, like the other shell, is ready to be fitted with rotating band and fuse.

To summarize: These shell can be produced in the method I have described so that

a wrought steel projectile can now be manufactured at less cost than a cast iron one, which, except for target practice, is almost worthless; and as for armor piercing shell, or even moulded steel shell, there can be no comparison as to cost of production. This same principle can also be applied to solving a still more difficult problem and one which has hitherto baffled the skill of the inventor, viz., the welding the solid heads onto the large brass cartridge cases now used with the projectiles of rapid fire guns. A rapid fire gun is one having a non-recoil and pivoted mount. It is aimed and fired from the shoulder like an old-fashioned swivel. They range in size up to as large as the six inch gun. The ammunition is fixed just the same as the bullet and cartridge of a shoulder rifle. At present, these brass cases are constructed with great difficulty and at much expense by drawing up from the solid ingot, and no one is prepared to make those of the large sizes in this country. By the Thomson process, which also welds brass and copper, this will be an easy matter and the cost should be less than one-fourth that now paid by the government for these they are obliged to import.

In conclusion, I will say that is a well-known fact among ordnance experts that the breech mechanism and the principle of the construction of the present high powered guns are entirely due to American invention, which was, however, forced out of the country by lack of appreciation and was taken up and developed in Europe. I believe the day has come at last when our military inventors will not have to seek their encouragement entirely abroad, and I think that in the very near future our government will be supplied entirely by cheap and effective projectiles of the kind I have shown you to-night.

The Franklin Fund.

The Boston Aldermen have notified the Massachusetts Hospital Life Insurance Company that, at the end of six months, the city will call upon it to turn over the principal and interest of the Franklin Fund, which now amounts to $368,000. The law requires that this term of notice shall be served. As yet no attachment has been placed on the funds in Boston, and it is the opinion of the trustees that nothing will be done as to legal proceedings by the heirs until the Philadelphia suit is settled.

Big Damages for Failure to Deliver a Telegram.

An opinion has just been handed down by the State Supreme Court in which $10,000 damages are awarded to J. T. Young, of Craven County, N. C., against the Western Union Telegraph Company.

Last year Young's wife was taken very ill in Columbia, S. C. Mr. Young was at New Berne, N. C., and his wife telegraphed him that she was sick and requested him to come to her at once. He did not get the message until six days later, and in the meantime Mrs. Young died and was buried; Young not knowing of either fact till all was over.

Young at once brought suit for damages in the Superior Court and won the case, but the Western Union appealed and carried the case to the Supreme Court, which has just confirmed the opinion of the court below.

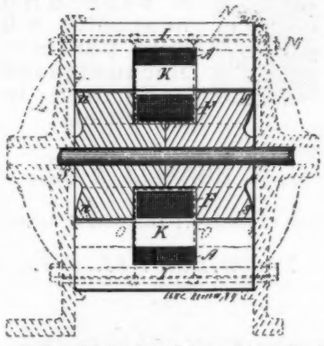
Beats Vivisection.

A cruel young friend of mine, says a writer in the New York *Star*, invited me to go to his "shop," which was formerly the nursery on the top floor of a Madison avenue residence, and I regretfully accepted, the other day. His father is wealthy and allows the young fellow a handsome sum of money every month to permit him to pursue his studies in electricity. It is a great fad with the youth, and who knows but what he may evolve some remarkable discoveries from his stubborn little brain. The "exhibition" which my young friend treated me to was the "electrocution" of rats and mice and their resuscitation. An electric light wire passes over the roof, and he has made a secret connection for experimental purposes. He shocked several rodents in various ways and they fell lifeless, to all appearances. "Now, you see they are dead," said the little chap, and then he proceeded to bury them in a box of earth. He left the noses of the rats and mice sticking out of the soil, and when everything was complete, he escorted me downstairs to lunch. After an absence of an hour, we returned to the "shop," and sure enough three of the victims showed signs of life. The largest animal was able to crawl out of the earth, and will probably live to be shocked again by the cruel young scientist who maintains that to "ground" on electrically shocked animal or person is to insure their recovery, provided the earth treatment is resorted to quick enough. He designs to give a seance soon, which will be attended by several well-known electricians.

SOME RECENT ELECTRICAL PATENTS.

ALTERNATING CURRENT GENERATOR.

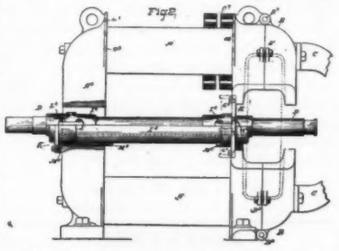
An ingenious dynamo-electric machine is described in a patent recently granted W. M. Mordey, of Lambeth, England. The machine has some points of resemblance to the generator recently brought out by Prof. Elihu Thomson, which has already been described in the REVIEW. As will be seen in the accompanying engraving, the machine comprises a rotating field magnet, *N S*, drawn by a spindle supported in bearings in heads *L L*, and polarized by a stationary coil *F*. The ends *N S* of the field magnet are star-shaped in end view, and as the field magnet rotates, the points of the star align



radially with laminated bars of iron *I* and *K* arranged at intervals around the field magnet and secured in place by being bolted to heads *L L*. The bars *I* and *K* alternate in position, the *K* series bridging the north and south poles of the field magnet inside of the armature coils *A*; the series *I* bridging the field magnet coils on the outside of said armature coils. As the points of the star confront the successive bars, the lines of force are led over the armature coils, inside or outside, thus alternately magnetizing and demagnetizing the bars, and inducing alternating currents in said armature coils. It will be understood from this that none of the coils of the machine, either the armature or field magnets, moves, the only movable part being the iron core *F* of the field magnet.

SECTIONAL POLE PIECE.

A dynamo electric machine, embodying a number of valuable structural features, has been patented by Mr. W. Hochhausen, of Brooklyn. In order to permit of easy removal of the armature, the pole pieces of the field magnet are made sectional, as shown in the engraving, and are hinged at B^3. The swinging pieces are normally locked to the fixed polar projection by bolts B^3, but upon removal of these bolts the pieces may be swung to the right and the armature removed. The field magnets are polarized by a series of coils wound upon independent spools, the heads of which are perforated



(0^3) for ventilation. These coils are connected to a series of contact blocks so arranged in the path of a switch that the number of field magnet coils may be varied; this switch is regulated by a small auxiliary motor, the field magnets of which are magnetic extensions of the pole pieces of the main machine. These extensions are partially shown at C C. The auxiliary motor also governs the position of the commutator brushes on the main machine so as to keep them at the neutral point. Under varying conditions of load or speed, the auxiliary motor will be correspondingly affected and will vary the power of the field magnets to preserve uniformity in the strength of current, and shift the brushes to the neutral point corresponding to the changed conditions.

MANUFACTURE OF METALLIC CARTRIDGE CASES.

The rapidity of progress in the electric art is strikingly illustrated by the great diversity of applications found for the heat developed in a conductor by the passage of an electric current. Of course, the principle has met with a wide practical application in incandescent and arc lighting for a number of years, but the facility with which it may be applied to metal working has only recently been appreciated. It has been a pleasure to the REVIEW, as well as a gratification to its readers, to note from time to time the various phases of its growth. In the accompanying engraving is illustrated a machine which will open up a new field of application. It is designed particularly by its inventor, Mr. Mark W. Dewey, of Syracuse, N. Y., for forming metallic cartridge cases, although with change of form in the dies it may be applied to the manufacture of a great variety of hollow metal ware. It is in effect a screw press with means for leading a current of sufficient volume to heat a metallic plate through the plate while being pressed into shape. The press is bolted to a bench *K'*. A plunger *C* is forced by screw pressure into a matrix *D*, a disk of copper, *B*, being laid over the matrix at the beginning of the operation. The plunger is in electric connection with one side of a supply circuit *FF*, through support *A*; the other side of the supply circuit is connected with an insulated cap *E*, slightly concave on the under side. The matrix

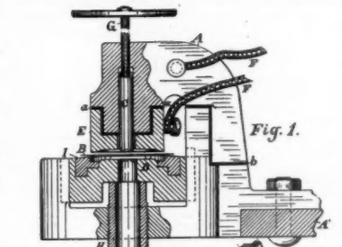


Fig. 1.

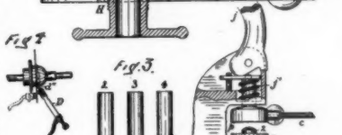


Fig. 3.

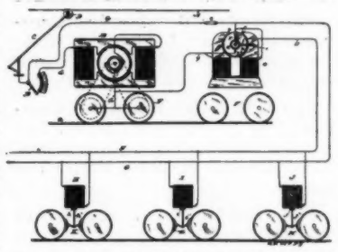
Fig. 2.

block is provided with a cutting edge *I*, to cut a disk of metal from a sheet. The instant such disk is pressed against cap *E*, the current passes through it in radial lines from plunger *C* to cap *E*, and heats the disk sufficiently to soften it. The depression of the plunger then forms a tube closed at one end (see 2 in Fig. 3). This tube is then placed over a countersunk die *K* (see Fig. 2), and a heading punch *P* is pressed down upon it. The die and matrix are insulated from each other and connected with the heating circuit; when punch *P* first contacts with the top of the tube 2, the circuit is completed and the metal softened, enabling the flange or head to be readily formed. The metal is softened so quickly as to enable the work to proceed rapidly.

The same principle is utilized in spinning metal articles upon a lathe, a former being connected with one terminal of the circuit and the tool with the other terminal, the heating and annealing being thus continued while the article is being spun (see Fig. 4).

BRAKING AN ELECTRIC TRAIN.

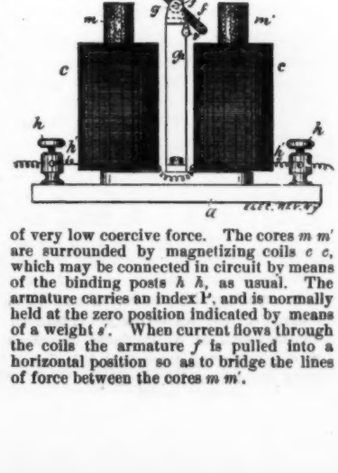
Electrically braking a railway car or train is, *per se*, an old idea. Mr. C. J. Van Depoele has recently patented a system of braking in which the adjustment of the current strength operating the brake mechanism is controlled by a counter electro-motive device of variable power, in lieu of the rheostats heretofore proposed for such purpose. The accompanying engraving illustrates the system. A represents the supply wire of the continuous current circuit, from which the current is led to the driving motor E of the train by means of a collector B, the return circuit being completed through the rails *a*. A branch wire, G, is carried through the train, and a series of solenoids, H I J, have each one terminal connected with the branch wire, the other terminal of each solenoid being connected to a wire, N, the end of which is carried by a movable brush, R, of a small motor, O, carried by the train. The



motor O is controlled by a switch, S, and when its circuit is completed it is connected with the driving motor E in multiple arc relation to the supply circuit. The movable brush, R, can be swung through an arc of 180 degrees on the commutator of the small motor. When it occupies the dotted position shown in the engraving, no current flows through the braking circuit, but as the brush R is shifted from the dotted position at the upper brush *q* toward the lower brush q^2, it makes successive contact with the commutator plates of the motor, and gradually permits more current to flow through the braking circuit, by reason of the cutting in of more coils of the ring armature between its terminals, and the consequent increase both of ohmic resistance and resistance due to counter electro-motive force between the brushes carrying the terminals of the wires N and G. So long as the brush remains in the dotted position there is no resistance between these terminals, for the reason that the brush R rests upon the same commutator segment as the brush *q*; the braking circuit is, therefore, short-circuited and no current flows in the solenoids H I J; but as the brush *r* is carried around the commutator towards brush q^2, the number of armature coils between the fixed brush *q* and the movable brush R is gradually increased and the amount of current shunted into the braking circuit proportionately augmented. The solenoids act upon movable cores and in any suitable manner, as, for example, by the toggle-joints shown, press brake shoes against the wheels of the train. The braking power may be thus fixed at any desired degree, by simply shifting the handle *r* attached to the movable brush of the small motor O.

CURRENT INDICATOR.

A current indicator, for measuring the strength of alternating or direct currents, is illustrated in the accompanying engraving. It is the invention of S. C. C. Currie, of Philadelphia. The characteristic feature of the device is the metallic texture of the cores *m m'* and of the pivoted armature *f*. These are formed of iron filings, chips or shavings, cemented into shape by silicate of soda, and form, when completed, a structure



of very low coercive force. The cores *m m'* are surrounded by magnetizing coils *c c*, which may be connected in circuit by means of the binding posts *h h*, as usual. The armature carries an index P, and is normally held at the zero position indicated by means of a weight *s'*. When current flows through the coils the armature *f* is pulled into a horizontal position so as to bridge the lines of force between the cores *m m'*.

KINDRED INTERESTS

The Electric Merchandise Company, of Chicago, has issued a supplemental catalogue of the Sprague electric railway material carried in stock by them.

The T. M. Foote Regulator Company, 271 Franklin street, Boston, have sent us a catalogue describing their intermediate speed regulator. It is evidently a very useful device.

The International Aluminum Works, 36-38 John street, New York, and 86 New street, Birmingham, England, are doing a large business in their electroplating specialties and dynamos.

The Short Electric Railway Company, Cleveland, O., is very busily engaged just now in filling a very large contract. The order is for 55 miles of track and 200 motors, for Rochester, N. Y.

The Empire City Electric Company, 15 Dey street, New York, are making large sales of the Fletcher corner cleat, Mason primary batteries, Acme gasoline torch, and a new circular arc switch recently brought out by them.

The Himmer & Anderson Dry Battery Company, 20 Vesey street, New York, are selling large numbers of their dry batteries. This little cell gives a current of from nine to 14 amperes at 1.75 volts, the internal resistance being .4 of an ohm. A representative of the ELECTRICAL REVIEW saw one of these batteries operating through 4,000 ohms resistance and giving 1.7 volts.

The Detroit Electrical Works have forwarded to Portland, Ore., the first shipment of their standard 30 horse-power motors and trucks (Rae system) as the forerunner of a large order. The Galveston, Tex., City Railway Company has contracted with the Detroit Electrical Works for a full electrical equipment of Rae motors and generators. The first installment of 20 motor cars and four generators with full station equipment will be in operation on or before January 1st, 1891. Col. Sinclair, president of the Galveston Railway System, made very exhaustive investigations of the various systems and his ultimate decision is a very high compliment to the Rae system.

English, Morse & Company, Kansas City, Mo., recently installed two Ide engines, of 100 and 50 horse-power, respectively, in the Bullene, Moore & Emery building, Kansas City. These engines are now under steam and doing good work. They are fitted with Hill clutch pulleys and are adapted to the most economical kind of service. The entire electrical plant in this building has not yet been placed. This company have also recently secured the contract for the system of Hill clutch pulleys, with shafting, floor stands, clutch couplings, etc., complete, which will be used in transmitting the power from two 250 horse-power Corliss engines to the dynamos in the Turkey Creek electric light station, in Kansas City.

The Westinghouse Company is manufacturing apparatus for several alternating current central station plants, which are already operating the Westinghouse system. There is the Oswego Electric Light Company, of Oswego, N. Y., where the capacity is not sufficient to meet the demand, and a 750 light machine is being added to the plant; and also at Lincoln, Neb., where the Lincoln Electric Light and Power Company has now been operating the Westinghouse alternating current system in a central station plant of 1,950 lights capacity will also have more light shortly, the company having just concluded a contract with the Westinghouse Company for apparatus to generate 1,000 sixteen candle-power incandescent lamps.

Alexander, Barney & Chapin.

This enterprising company is enjoying a rush of business such as seldom comes to a firm so young. It is a good instance of what valuable experience and push can do in organizing a company on business principles and for strictly business purposes.

The company has made arrangements to sell Edison lamps of all sizes at Edison prices. Thomson-Houston and Edison electric railway supplies of all kinds will be kept in stock. They have brought out a new incandescent lamp, called the "A. B. C." It is stated that it will compare in efficiency and life most favorably with standard lamps.

With the large variety of Queen's measuring and testing instruments, which they sell at the manufacturer's prices, and other electrical goods which they control exclusively, their customers are sure to find their wants supplied, and the volume of business cannot help but increase right along.

Few supply houses in the country have such exceptional facilities for filling orders for all kinds of electrical goods.

A District Beer Call System.

Quite an novel application of electricity is reported from an enterprising town in Texas, it being practically a system of district calls, in answer to which a supply of beer is sent to any of the call stations. It so happens that a wide-awake merchant controls all the saloons in the place, as well as some ice-houses, and in order to save the expense of keeping a stock at each saloon, he has hit upon the call system as the simplest and best medium. He accordingly carries but a small supply at each of the refreshment places, and keeps the bulk of beer and ice at one central point, from which a fresh lot can be promptly sent to any of the saloons on receipt of call from that place. The cost of installing the system is so low that it is expected to pay for itself very quickly by the saving effected in ice, to say nothing of its convenience. The Great Western Electric Supply Company furnished the apparatus.

FINANCIAL.

Closing quotations of electric stocks, from F. Z. Maguire, Electrical Securities, 18 Wall street, N. Y., Saturday, October 25, 1890. New York, Boston and Washington Stock Exchanges.

NEW YORK.	
Western Union Telegraph Co	81.
Edison General Electric Co	95.
" " " Deferred	88.
Consolidated Electric Light	
Edison Electric Illuminating Co	68.
United States Electric Light	30.
BOSTON.	
Thomson-Houston Electric Co	51½.
" " " Preferred	26½.
" " " Series C	11½.
" " " Series D	6⅛.
" " International	
" Welding Co	185.
" European Welding Co	60.
Ft. Wayne Electric Co	12½.
Westinghouse Electric Mfg. Co	29.
TELEPHONE:	
American Bell	220.
Erie	50.
New England	52.
Mexican	.75
MISCELLANEOUS:	
Edison Phonograph Doll	2.
WASHINGTON.	
Pennsylvania Telephone	25.
Chesapeake and Potomac	*68.
American Graphophone	14½.
United States Electric Light (Washington)	150.
Eckington and Soldiers' Home Railway	65½.
Georgetown and Tennallytown	49.

*Ex. Dividend.

THE LAW BATTERY

IS THE CHEAPEST BATTERY ON THE MARKET.

We think twice before spending a Dollar and would advise you to do the same. We make a specialty of Pure Zinc and Pure Sal-Ammoniac.

LAW TELEPHONE CO.,

85 & 87 JOHN ST., NEW YORK.

F. Z. MAGUIRE,

ELECTRICAL SECURITIES, ETC.,

18 WALL STREET,

NEW YORK.

ELECTRIC AND STREET RAILWAY PROPERTIES BOUGHT AND SOLD.

Burnley Dry Battery

PATENTED JAN., 1890.

STRONGER than any Open Circuit Battery on the Market. BETTER than any other Dry Battery yet produced. Most compact in size and cheapest. 90 cents per cell. Discount to the Trade and in quantities.

J. H. BUNNELL & CO.,

Sole Manufacturers and General Agents,

76 CORTLANDT ST., N. Y.

PATENT PERFORATED ELECTRIC LEATHER BELTING

MANUFACTURED BY

Charles A. Schieren & Co.,

45, 47, 49, 51 FERRY ST.,

COR. CLIFF ST.

BRANCHES:

BOSTON, 119 HIGH STREET.
PHILADELPHIA, 226 NORTH 3d STREET.
CHICAGO, 46 SOUTH CANAL STREET.

LAMP MAKER—OR PROCESS.

PARTIES WISHING TO MAKE a high class incandescent lamp up to 130 volts—No humbug—Or a series lamp up to 10 amperes and 350 c. p. to the E. H. P., can secure either or both, and the man. After Nov. 1st, would take an interest in a good concern as part pay.

Address,
"No. 121."
Care of ELECTRICAL REVIEW.

ERIE RAILWAY.

THE Picturesque Route of America. Via Niagara Falls or Chautauqua Lake. An enchanting panorama of mountains, forests and streams.

SOLID TRAINS between New York and Chicago. No change of cars. VESTIBULED LIMITED (strictly first-class) without extra charge for fast time and superior service.

W. C. RINEARSON,
General Passenger Agent

INVENTORS

Coming to Washington to further any electrical patents, will profit by calling on C. W. Messner, of 1225 F St., N. W. All the appliances necessary for tests, experiments, etc. Also, Electrical Contractor and Constructor. Special attention to isolated plants. Agent for the "C. & C." electric motor—sizes, ⅛ to 50 horse-power. The only electric motor on the market to-day.

YOU make a mistake if you don't buy your Electrical Supplies from F. & F., Cleveland, O.

LOOK AT THESE PRICES:

$2 Electric Bells, 50c., 75c. Bronze.
Push Buttons, 25c.; 25c. Wood Push.
Buttons, 7c.; 50c. Switches, 15c.
40c. Bell Hangers' Staples, per lb., 10c.
$1 Leclanche Batteries, 45c.
$1 Carbon Batteries, 40c.
$3.75 Spark Coils, $1.50; $10 Medical Batteries, $3.50.
Dry Batteries, Motors, Dynamos and Annunciators at half price. Send for reduced price list and discounts.

Fletcher & Fletcher Electric Co., Cleveland, O.

ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENTS OF THE UNITED STATES WERE ISSUED ON OCTOBER 22, 1890.

438,598 Electrical water alarm; Francis M. Ashton, Lima, O.

438,602 Alternating current generator and motor. 438,603 Electric motor; Chas. S. Bradley, Yonkers, N. Y.

438,619 Arc and incandescent lighting system; John E. Giles, Hazleton, Pa.

438,620 Electric crossing gate; Harleigh Gillette, Highland Park, Ill.

438,631 Telephone transmitter. 438,632 Telephone; Archibald J. MacDonald, North Tiverton, R. I., assignor to Henry E. Townsend, trustee, Boston, Mass.

438,653 Electric guest call; Alexander Striemer, Sleepy Eye, Minn.

438,656 Electric motor; Elihu Thomson, Lynn, Mass., assignor to the Thomson-Houston Electric Co., of Connecticut.

438,657 Process of electric welding. 438,658 Electric welding of pipes; Elihu Thomson, Swampscott, Mass., assignor to the Thomson Electric Welding Co., of Maine.

438,668 Brushholder for dynamo-electric machines; Chas. F. Winkler, Troy, N. Y.

438,719 Motor car; Edmond Verstraete, St. Louis, Mo.

438,721 Thermal cut-out; Geo. H. Whittingham, Baltimore, Md., assignor to the Automatic Switch Co., same place.

438,723 Electric blank heating and feeding apparatus for forging machines; Geo. D. Burton, Boston, Mass.

438,767 Electro-pneumatic clock; Victor Poff, Paris, France, assignor to the Poff Compressed Air and Electric Power Co., Limited.

438,773 Electric light pole; Patrick J. Dinn, Boston, Mass.

438,779 Extension device for incandescent lamps; Samuel O. Newton and Melville A. Newton, North Pitcher, N. Y.

438,780 Electro-magnet; Frederick M. Schmidt, Brooklyn, N. Y.

438,784 Telephone; Jno. C. H. Stub, San Francisco, Cal., assignor to the American Bell Telephone Co., Boston Mass.

438,788 Lighting arrester; Anthony C. White, Boston, Mass.

438,814 Device for automatically insulating broken wire; Max Kerstein, Boston, Mass., assignor of one-half to Rudolph Furgang, same place.

438,818 Telephone; James W. McDonough, New York, N. Y.

438,827 Secondary battery; Emile M. Reynier, Paris, France.

438,828 Telephone; Wilton L. Richards, Malden, Mass.

438,837 Electric drill; Gordon Buchanan, Chicago, Ill.

438,847 Electric railway; Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Co., of Connecticut.

438,879 Magneto-electric transmitter; Archibald E. Todd, Providence, R. I.

438,891 Electrical speculum; Samuel H. Linn, Rochester, N. Y.

438,894 Trolley switch for electric railways; Henry W. Marcy, Utica, N. Y.

438,928 Pneumatic railway system; Geo. N. King, Washington, D. C.

438,934 Insulator; Fidel Miro, Cienfuegos, Cuba.

438,982 Telephone exchange apparatus; Franklin G. Beach, Chicago, Ill., assignor to the American Bell Telephone Co., Boston, Mass.

439,011 Arc lamp; John Kent, London, England.

439,015 Electric station indicator; Geo. H. Kirwan, Wilkesbarre, Pa.

439,017 Apparatus for the rhythmic generation of electric currents; Chas. Langdon Davis, London.

439,023 Device for raising and lowering electric or other lights; David B. Matson, Watkins, N. Y., assignor of three-fourths to Rachel I. Smith, Catlin, N. Y.

439,042 Electrical transmission of power; William Stanley, Jr., Great Barrington, Mass., assignor to the Westinghouse Electric and Manufacturing Co., Pittsburgh, Pa.

439,047 Electric lamp socket with regulating attachment; William F. Wollin and Elmer H. Werline, York, Pa.

439,055 Electrically controlled lock for fire arms; Albert Von Duschan, Emden, Germany.

439,069 Electric railway; Rudolph M. Hunter, Philadelphia, Pa., assignor by mesne assignments to the Thomson-Houston Electric Co., Boston, Mass.

439,070 Electric railway; Rudolph M. Hunter, Philadelphia, Pa., assignor to the Electric Car Co. of America, same place.

We desire to meet proper parties to form the Writing Telegraph Company of South America.

The conditions will be very reasonable.

WRITING TELEGRAPH CO.,

57 MURRAY ST., N. Y.

Daniel W. Baker. Cyrus O. Baker, Jr.

BAKER & CO.,
Importers, Melters and Refiners of
PLATINUM,
408, 410, 412 and 414 N. J. R.R. Ave., NEWARK, N. J.
Platinum in sheet and wire, all sizes, and any degree of hardness. Scrap and native platinum purchased

SUPPLIES FOR ALL SYSTEMS.
Prompt Shipments. Write for Prices.
W. H. GORDON & CO.,
ELECTRIC LIGHT AND POWER SUPPLIES,
SIMPLEX WIRES. *115 Broadway, New York.*

ELECTRICAL MEASUREMENT
Instruments and Batteries of the Very Highest Grade.
Precision and Constancy, Quality and Finish the Best in the World.
Catalogue of Standard Test Instruments furnished upon application.
THE E. S. GREELEY & CO.,
5 AND 7 DEY ST., NEW YORK.

W. R. OSTRANDER & CO.
195 & 197 FULTON ST., NEW YORK.
Manufacturers of
SPEAKING TUBES, WHISTLES, ANNUNCIATORS, Electric and Mechanical Bells.
FACTORY,
De Kalb Ave.,
BROOKLYN.
Send for Illustrated Catalogue.

STANDARD ELECTRIC TEST INSTRUMENTS.
AMMETERS AND VOLTMETERS FOR DIRECT AND ALTERNATING CURRENTS.

QUEEN'S NEW Portable Combination Testing Set, WITH GALVANOMETER.
WE PAY SPECIAL ATTENTION TO RECALIBRATING AMMETERS AND VOLTMETERS.
SEND FOR CATALOGUE I-66 OF ELECTRIC TEST INSTRUMENTS.
QUEEN & CO., - Philadelphia, Pa.

SEND FOR CATALOGUE.

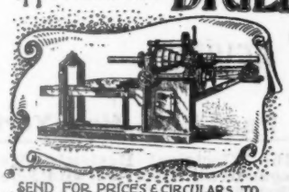
THE WYCKOFF PIPE CO.,
MANUFACTURERS OF
WOODEN PIPES FOR
UNDERGROUND ELECTRICAL WIRES.
We have large works for creosoting Lumber, R. R. Ties, Telegraph Poles, &c., &c.
WILLIAMSPORT, PENN.

OTIS ELECTRIC ELEVATOR,
FOR
STORES, OFFICE BUILDINGS AND RESIDENCES.
A CUT OF IT WILL APPEAR IN OUR NEXT ISSUE.
Otis Brothers & Co., 38 Park Row, New York.

SILKS.
Full assortment of different sizes and qualities on **BRAIDER SPOOLS,** ready for the machines, in Red, Yellow and Green. Other colors to order. **Send for Sample and Prices.**
WM. MACFARLANE, & CO., 81 Grand Street, New York.
Telephone No. 971 Spring. Mill, Bergen Point, N. J.

MACKITE AN IMPROVEMENT ON THE PRESENT METHOD OF ROUGH PLASTERING. Manufactured in any length slabs from 1-2 to 6 inches thick. Plastering done in one-tenth the time of old way, winter or summer. No waiting for walls to dry out. No dirt, as in case of plasterer's mortar. Less weight, less conductivity of cold or heat. Can be used for deafening, back-plastering, non-conducting or isolating partitions, furring, floors, roofs, etc. FIRE-PROOF, EASILY TRANSPORTABLE.
EASTERN PLASTER BOARD CO., 52 Broad St., New York.

Horizontal **DRILLING AND BORING MACHINE**



Great Power.
WIDE RANGE OF
REVERSIBLE FEEDS.
SEND FOR PRICES & CIRCULARS TO
THE NEWARK MACHINE TOOL WORKS. Newark, N.J.

EUGENE F. PHILLIPS, PRESIDENT. W. H. SAWYER, SEC. & ELECTRICIAN.

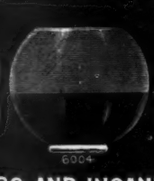
AMERICAN ELECTRICAL WORKS,

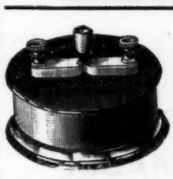
Manufacturers of Patent Finished
ELECTRIC LIGHT WIRE,
MAGNET WIRE, OFFICE & ANNUNCIATOR WIRE.
RUBBER COVERED WIRE, LEAD ENCASED WIRE.
TELEPHONE & INCANDESCENT CORDS.
FARADAY CABLES.
Office and Factory, 67 STEWART STREET., PROVIDENCE, R. I.
New York Office, 10 Cortlandt St., P. C. Ackerman, Agt.

EUGENE F. PHILLIPS, PRESIDENT. JOHN CARROLL, SEC'Y-TREAS.

EUGENE F. PHILLIPS ELECTRICAL WORKS, LTD.

Manufacturers of
ELECTRIC LIGHT WIRE,
MAGNET WIRE, OFFICE & ANNUNCIATOR WIRE,
RUBBER COVERED WIRE, LEAD ENCASED WIRE,
TELEPHONE & INCANDESCENT CORDS.
FARADAY CABLES.
OFFICE AND FACTORY
St. Gabriel Locks. MONTREAL, CANADA.

PHŒNIX GLASS CO
OF PITTSBURGH, PA.
MANUFACTURERS OF A FULL LINE OF
ELECTRIC LIGHT
GLOBES  **SHADES**
BOTH ARC AND INCANDESCENT.
RICH CUT, OPAL, CLEAR, ETCHED, ROUGHED, ETC.
ADAPTED TO ALL SYSTEMS.
729 BROADWAY, NEW YORK.
(COR. WAVERLY PLACE), AND
43 SIXTH AVE., PITTSBURGH, PA.



ELECTRIC CONDENSERS
WM. MARSHALL, MANUFACTURER.
Standards a Specialty.
Rooms 2 and 4, University Building, New York.

THE LEHIGH VALLEY
CREOSOTING CO.
WORKS, PERTH AMBOY, N. J.
Office, Foot of Washington Street, JERSEY CITY, N. J.
Creosoted Lumber, Underground Conduits, Telegraph Poles, Piling and Ties Furnished.

HYDRAULIC PRESSES.
ALL VARIETIES.
PUMPS, VALVES, GAUGES AND FITTINGS, PUNCHES, SHEARS, BUFFING MACHINERY, &c.
WATSON & STILLMAN,
210 EAST 43D STREET, NEW YORK CITY.
Special Attention to Electrical Work.

TRADE **GONDA** MARK.

BATTERIES.
THE STANDARD OPEN CIRCUIT BATTERIES OF THE WORLD!
For 20 years these Batteries have maintained their superiority over all others and stand to-day unequalled and unapproachable. Refuse to take any cell unless it bears the Trade Mark, "Gonda."
The Leclanché Battery Co.,
NEW YORK.

ADVANTAGES OF THE EVANS SYSTEM OF DRIVING DYNAMOS.

ECONOMY IN ROOM.

No loss of room by reason of long lines of belting. All the space is made available. More than double the number of dynamos can be put in the same space than by ordinary belting. In the erection of new stations, or the increase of old, an immense saving is realized.

EFFICIENCY.

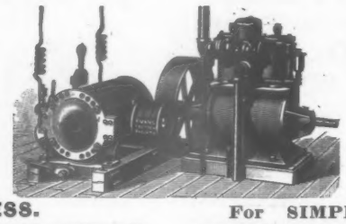
There is no slip. Consequently there is less loss of power in transmission, and a steady light is obtained. There is also less pressure on the bearings than by ordinary belting for the same amount of power.

SAVING IN BELTS.

Belts cost less than one-tenth of ordinary belts, and last over twice as long. The saving in belts alone nearly pays the royalty.

SIMPLICITY AND COMPACTNESS.

The dynamo pulley is placed in immediate contact with the driving pulley. No expensive clutches or complicated belt holders are necessary. The Evans Friction is a perfect clutch in itself.



PERFECT CONTROL.

Each and every dynamo can be stopped or started independently of every other without slowing or stopping the engine or other motive power.

FOR POWER GENERATORS.

Where the load is intermittent and subject to sudden changes, as in street railway work, the Evans Friction adapts itself promptly and effectively to the work without the "flop" or unsteady motion of ordinary belting.

CLEANLINESS.

The Evans System does away with long flying belts which carry a large amount of dust, and not only is the room cleaner, but the bearings are freer from grit.

For SIMPLICITY, COMPACTNESS, ECONOMY, EFFICIENCY and CLEANLINESS, the EVANS SYSTEM surpasses anything yet devised for driving dynamos.

Send for Catalogue "D" to the EVANS FRICTION CONE CO., 85 Water Street, Boston, Mass.

LIST OF DYNAMOS IN STOCK.

Designation of Machine.	No. Lights 2,000 c. p. 10 amp. X	No. Lights 1,600 c. p. 8 amp. Y	No. Lights 1,200 c. p. 6 amp. Z	No. Lights 800 c. p. 4 amp.	Horse-Power at Pulley of Dynamo.	Width of Single Belt in Inches.	Belt Speed Required.	Weight of Dynamo.
C	8	.....	.....	.....	6.5	1¼	5,000 FEET PER MINUTE.	530
D	.....	10	.....	.....	6.3	1 25/32		530
E	.....	.....	.....	25	8.0	2		530
F	16	.....	.....	.....	12.0	2 5/16		780
G	.....	20	.....	.....	12.5	2 3/32		780
H	.....	.....	26	.....	13.0	2 3/16		780
I	20	.....	.....	.....	15.0	3		990
J	.....	25	.....	.....	15.6	3		990
K	.....	.....	32	.....	15.0	3		990
L	.....	.....	.....	50	16.0	3		990
M	28	.....	.....	.....	21.0	4 1/16		1,360

Hall Electric Light Co.,
404
WEST 27th STREET.
NEW YORK.

LIST OF DYNAMOS IN STOCK.

Designation of Machine.	No. Lights 2,000 c. p. 10 amp. X	No. Lights 1,600 c. p. 8 amp. Y	No. Lights 1,200 c. p. 6 amp. Z	No. Lights 800 c. p. 4 amp.	Horse-Power at Pulley of Dynamo.	Width of Single Belt in Inches.	Belt Speed Required.	Weight of Dynamo.
G	.....	35	.....	.....	21.0	4	5,000 FEET PER MINUTE.	1,360
G	.....	.....	45	.....	21.0	4		1,360
G	.....	.....	.....	70	21.0	4 1/16		1,360
H	40	.....	.....	.....	29.7	6		1,750
H	.....	50	.....	.....	30.0	6		1,750
H	.....	.....	64	.....	29.5	6		1,750
I	52	.....	.....	.....	38.0	8		2,290
I	.....	65	.....	.....	38.6	8		2,290
I	.....	.....	88	.....	38.0	8		2,290
J	64	.....	.....	.....	46.5	10		2,770
J	.....	80	.....	.....	47.1	10		2,770
K	75	.....	.....	.....	52.5	12		3,200

The Burton Electric Heater for Electric Railway Cars

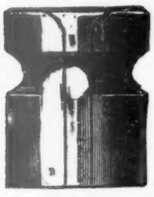
NO SMOKE! NO GASES! EASILY MANAGED! ECONOMY IN SPACE!

Normal use of current, THREE AMPERES, and the cost of this is in the coal burned at the generating station, which is actually LESS than that of coal burned in a stove on a car.

"They are giving us and the public entire satisfaction."—RICHMOND, VA., U. P. RY. CO.
"The heat is pleasant, sufficient and economical."—MARLBOROUGH, MASS., STREET RY. CO.
"We are much pleased with them, and know of no reason why we shall not continue to use them and recommend them to others."—ST. LOUIS AND EAST ST. LOUIS ELECTRIC RY. CO.

AGENCIES: { Equitable Electric Ry. Construction Co., 416-420 Commercial Union Building, Phila., Pa.
Higgins Brothers & Co., 202 Main Street, Buffalo, N. Y.
Electric Merchandise Co., 11 Adams Street, Chicago, Ill.

For Further Information, Address
THE BURTON ELECTRIC COMPANY, RICHMOND, VA.



Porcelain Electrical Supplies and Specialties,

MANUFACTURED BY

EMPIRE CHINA WORKS,

144 & 156 Greene St., GREENPOINT, BROOKLYN, E. D., N. Y.

Our Ware is HARD PORCELAIN, the BODY and GLAZE IDENTICAL, and GUARANTEED NON-CONDUCTIVE for all ELECTRICAL PURPOSES.

THE American Bell Telephone Company,

95 MILK ST., BOSTON, MASS.

This Company owns the Letters Patent granted to Alexander Graham Bell, March 7th, 1876, No. 174,465, and January 30, 1877, No. 186,787.

The Transmission of Speech by all known forms of ELECTRIC SPEAKING TELEPHONES infringes the right secured to this Company by the above patents, and renders each individual user of telephones, not furnished by it or its licensees, responsible for such unlawful use, and all the consequences thereof and liable to suit therefor.

WHEN Writing for Catalogues, Information or Prices, **YOU WILL CONFER A FAVOR** on both the **ADVERTISER** and the **PUBLISHER** by mentioning the fact that you saw the advertisement in the ***ELECTRICAL REVIEW.***

"The Electric Railway of To-Day."

—BY—

H. B. PRINDLE,

OF BOSTON.

HANDSOMELY ILLUSTRATED.

THE SUBJECT POPULARLY TREATED.

An Able and Interesting and Timely Publication.

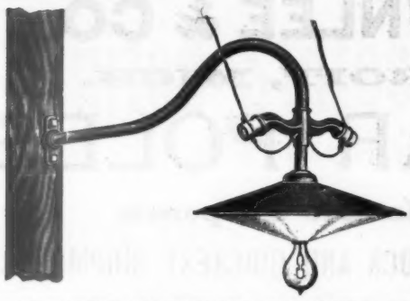
PRICE, 50 CENTS.

ADDRESS:

ELECTRICAL REVIEW,

13 Park Row, New York.

WRITE For the Electrical Review's *New Catalogue* of all Electrical and Scientific Books.
18 PARK ROW, NEW YORK.



INCANDESCENT LAMPS FOR ARC LIGHT CIRCUITS

ESPECIALLY DESIRABLE FOR STREET AND STORE LIGHTING.

A NECESSITY TO EVERY LIGHTING CO. ✳ ALL OUTSIDE PARTS OF INSULATING MATERIAL.

INCANDESCENT LAMPS FOR MULTIPLE CIRCUITS

ANY VOLTAGE. CAPPED FOR ANY SOCKET.

BERNSTEIN ELECTRIC CO.

CHICAGO OFFICE, 190 FIFTH AVE., GEO. CUTTER, Agt.

620 ATLANTIC AVENUE, BOSTON, MASS.

NASSAU ELECTRICAL SPECIALTIES.

ACTUAL SIZE.

E. M. F., 1.07. Current, 2.20 amperes.

CAPSULE BATTERY.

(Patented Aug. 19, 1890.)

SMALLEST EFFECTIVE BATTERY IN EXISTENCE.

PERFECTLY DRY.

Does not Require Wiring.

Never Polarizes.

Power Constant.

Sample by mail, $1.10.

ELECTRICAL BELL OUTFIT.

(Patented Aug. 19, 1890.)

The Simplest and Most Complete Portable Bell Outfit in the market. The bell is operated by the Nassau Capsule Battery, concealed in the case of the push button.

This battery is not connected by wires and can by withdrawn and replaced by the user instantaneously when a renewal is necessary.

Electric Alarm Thermometer.

(Patented Aug. 19, 1890.)

This thermometer sounds an alarm whenever the temperature rises above or falls below any required point.

It is designed for use in Offices, Schools, Hospitals, Living Rooms, Baths, Breweries, Factories and all places where the maintenance of an equable temperature is desirable.

It can be arranged to sound at any distance from the thermometer, and can thus be used as an infallible guard against fire.

NASSAU ELECTRICAL CO., 19 Park Place, New York.

✳SAWYER-MAN✳

ANY CANDLE POWER. LAMPS TO FIT ANY SOCKET.

New Series Lamp and Socket

FOR ARC CIRCUITS.

SAWYER-MAN ELECTRIC CO.

510-534 West 23d Street,

SEND FOR CATALOGUE. ✳ NEW YORK.

DUST PROOF BELLS.

STANLEY & HALL,

Formerly HAZAZER & STANLEY,

32 & 34 Frankfort Street, New York.

BROWNLEE & CO.,

DETROIT, MICH.

CEDAR POLES

For Electric Purposes.

THE LARGEST STOCK AND QUICKEST SHIPMENTS.

☞ Manufacturers of the Celebrated Octagonal Red Pine Poles for Electric Railways and Electric Lighting; also Manufacturers of Cross-Arms and Pins.

THE TUBES OF THE

INTERIOR CONDUIT AND INSULATION COMPANY

ARE ESPECIALLY APPLICABLE TO

ELECTRIC RAILWAY REQUIREMENTS.

A Simple Solution of the Wiring Problem for Public Buildings, Residences, Factories, Station Work, Cars, Underground Feeders, and all places where insulation is required.

INTERIOR CONDUITS.

Endorsed by the Leading Electricians, Electric Light Companies, Wiring Contractors, Architects, Builders and Boards of Fire Underwriters.

UNDERGROUND CONDUITS

Are equally successful, and afford Cheapness, High Insulation and Durability.

For Catalogue, Price List and General Information, address

INTERIOR CONDUIT AND INSULATION COMPANY,

16 and 18 BROAD STREET, NEW YORK CITY. *EDWARD H. JOHNSON, Prest.*

ELECTRIC MERCHANDISE COMPANY,

Opposite Pullman Building, 11 ADAMS STREET, CHICAGO, ILL.

THE ONLY COMPANY IN THE UNITED STATES MAKING AN EXCLUSIVE BUSINESS OF MANUFACTURING

ELECTRIC RAILWAY SUPPLIES

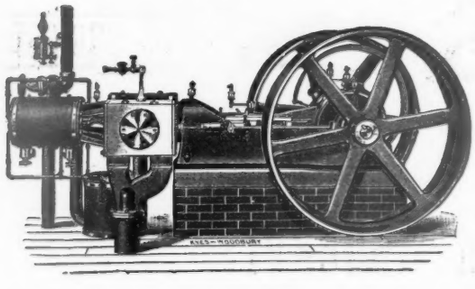
FOR ALL SYSTEMS.

W. R. MASON, Gen'l Manager.

Standard and Special Designs for Car, Station and Line Work.
CATALOGUES FURNISHED. CORRESPONDENCE SOLICITED.

WESTERN POWER CONSTRUCTION CO.,

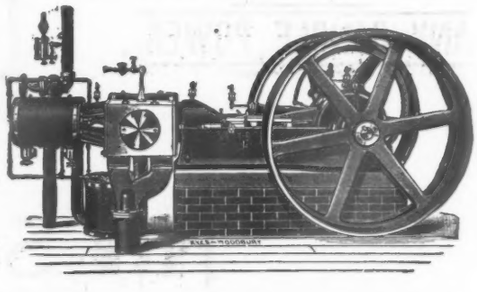
ROOKERY BUILDING, 144 ADAMS STREET, CHICAGO.



McINTOSH & SEYMOUR

TANDEM COMPOUND STEAM
JACKETED CYLINDERS,
SUPERHEATING RECEIVER,
PATENTED VALVE SEAT,
AUTOMATIC RELIEF VALVES.

NOT HOW CHEAP, BUT HOW GOOD.



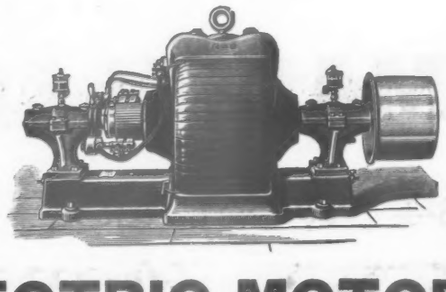
Complete Steam Plants erected for Electric Light, Railway Duty and Power Purposes.
Correspondence Solicited.

"C. & C." ELECTRIC MOTORS.

The only Motors in which the magnetic circuit forms a perfect circle around the centre of the armature shaft. Thus making the most compact and efficient form of machine that can possibly be devised.

One-eighth horse-power to 50 horse-power in stock.

OVER 10,000 MOTORS IN ACTUAL OPERATION.



FAN OUTFITS.

Electric Blowers for Ship Ventilation.

MOTORS FOR HOISTS AND MINING TRAMWAYS.

Equipment of Machine Shops, Printing Offices, Factories and Entire Buildings, with Electric Power.

New England Office, 63 Oliver Street, Boston.
Philadelphia " 38 South Fourth Street.
Chicago " Phenix Building.

"C. & C." ELECTRIC MOTOR COMPANY,

402 & 404 Greenwich Street, New York.

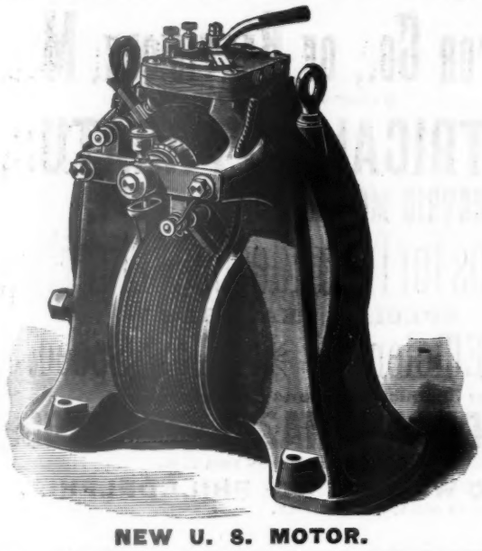
The United States Electric Lighting Company,

(WESTINGHOUSE ELECTRIC CO., Lessees.)

Arc and Incandescent Isolated Electric Light Plants.

AUTOMATIC DYNAMOS. PERFECT DEVICES.

More than 1,000 Plants in Operation in Mills, Hotels, Office Buildings, Theatres, Etc.



NEW U. S. MOTOR.

ELECTRIC MOTORS AND GENERATORS.

Direct Current Generators and Motors for all purposes. 1-8 horse-power up to any power desired, and of any required E. M. F. Superior in Design and Workmanship, and Unequalled in Efficiency.

SEND FOR NEW U. S. CATALOGUE ON INCANDESCENT LIGHTING AND MOTORS.

General Offices: EQUITABLE BUILDING, 120 Broadway, New York.

SOUTH LAKEWOOD PARK

THE ELECTRIC CITY.

ADJOINING LAKEWOOD, NEW JERSEY.

Lots 50 x 100, also plots from one-fourth acre to one acre, with young growing Oaks and Pines which can be trimmed to suit purchaser.

Land dry and elevated, 40 feet higher than Lakewood.

Climate the most suitable for a winter home.

The demand for winter homes is unprecedented and we fear that the extent of territory from Lakewood to Manchester will not be sufficient to meet the demand.

We have, therefore, raised the price of lots to **$250** until further notice. Town restricted to the very best.

Send for maps and particulars. Apply to or address,

Dr. DeLERY, Manager,

5 & 7 DEY STREET.

ARC LAMPS FOR INCANDESCENT CIRCUITS.

THE UNIVERSAL ARC LAMPS. These lamps are intended for direct current circuits, giving a steady and noiseless light, and can be adjusted for circuits having a pressure from 100 to 125 volts, using from eight to nine amperes; when burning two in series, the resistance is coiled about the chimney at the top of each lamp, within which the carbon rod is suspended, thereby rendering any additional resistance unnecessary.

Electric light stations and owners of isolated plants using low potential currents will do well to examine this lamp before purchasing elsewhere, as our claim for the lamp is that it is the best article in the market.

THE UNIVERSAL THEATRICAL ARC LAMP. This lamp is manufactured for stage uses, taking the place of the calcium lights, and can be used wherever constant direct circuits exist; it is easily handled and has all the effects of the calcium, and the cost of running same being very much cheaper than the old-fashioned method. We are prepared to furnish complete outfits at shortest notice; prices and references on application.

FOR PRICES AND FURTHER INFORMATION, APPLY TO

THE UNIVERSAL ARC LAMP COMPANY,

MANUFACTURERS OF

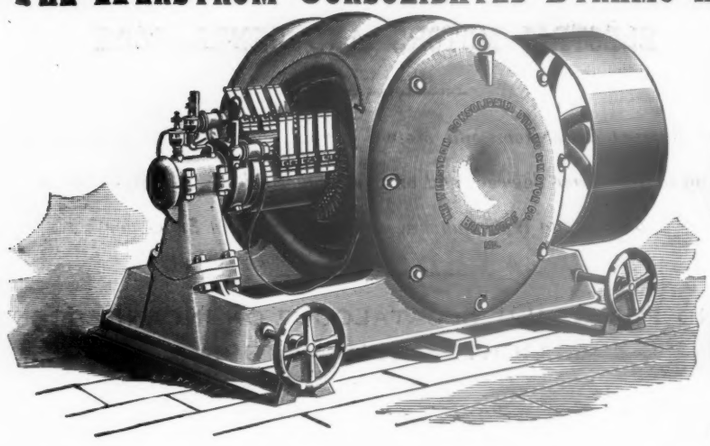
THE UNIVERSAL SYSTEM OF ARC LAMPS AND THE UNIVERSAL THEATRICAL ARC LAMPS.

EXECUTIVE OFFICE: 16 AND 18 BROAD STREET. SALESROOMS: 49 WEST 22d STREET.

J. H. McCLEMENT, President. E. S. MENDELS, General Manager.

THE WENSTROM CONSOLIDATED DYNAMO AND MOTOR CO., OF BALTIMORE, MD.,

MANUFACTURERS OF



ELECTRICAL APPARATUS,

ELECTRIC MOTORS FOR ALL WORK,

Dynamos for Incandescent Lighting.

SPECIAL FEATURES:

High Efficiency. Slow Speed.

For full information and circulars address,

CHADBOURNE, HAZELTON & CO.,

SOLE SELLING AGENTS FOR U. S.,

416-420 WALNUT ST., PHILADELPHIA.

AGENTS WANTED IN ALL LEADING CITIES.

BUY THE

SCHUYLER APPARATUS

IF YOU WANT THE BEST

Arc Lighting System.

Office and Factory:

MIDDLETOWN,

CONN.

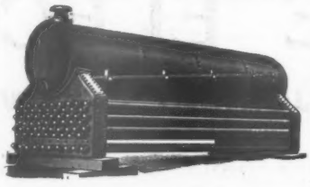
THE HEINE SAFETY BOILER CO.

PATENT SAFETY WATER TUBE STEAM BOILERS.

NO CAST IRON PARTS. ALL PLATE STEEL.

No contracted openings to drum, but full area of tubes carried out, thus assuring free circulation and dry steam. Adapted for all kinds of water and fuel. Manufactured both in the East and West. Send for Illustrated Catalogue.

707 Bank of Commerce Building, St. Louis, Mo.,



—OR TO—

Heine Safety Boiler Co.....82 Madison St., Chicago, Ill.
Risdon Iron Works..... .....San Francisco, Cal.
Stearns, Roger & Co.....3 Duff Block, Denver, Col.
R. M. Huston.....Room 169, 45 Broadway, New York
Jos. K. Rugg & Co..107 West Second St., Cincinnati, O.
Van Zile, MacCormack & Co.....Albany, N. Y.
L. Metesser.....34 St. Charles St., New Orleans, La.
T. C. Gooch.....448 West Main Street, Louisville, Ky.
English, Morse & Co. 1221 Union Ave., Kansas City, Mo.
Seeger & Guernsey Co.....City of Mexico, Mexico.
Jas. H. Harris.....82 Madison Street, Chicago, Ills.

AGENTS.

Magneto WATCHMEN'S Time Detector.

Watchmen's REGISTER, WITH REGULATOR.

THE

Holtzer-Cabot Electric Co.,

MANUFACTURERS OF

Electric Light and Power Supplies,
Electric Bells and Annunciators.

OUR "ACME"

Magneto Watchmen's Register is the Simplest, Best and Most Reliable.

MAGNETO TESTING GENERATORS, FOR ELECTRIC LIGHT TESTING—WILL RING THROUGH 2,500 TO 3,500 OHMS RESISTANCE.

Extra Strong Power Generators to Order.

Send for Catalogue.

Office and Salesrooms: 111 ARCH STREET, BOSTON.

Factory: BROOKLINE, MASS.

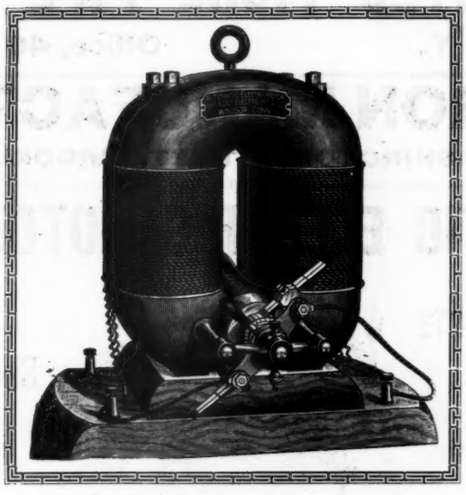
"HOLTZER" Cylinder Battery. IT HEADS All Competitors.

ALL FIRST-CLASS ELECTRICIANS ENDORSE The "Holtzer."

FOR ECONOMICAL REASONS

USE

THE EDDY MOTOR.



It requires a Minimum of repairs and attention.

HIGHEST EFFICIENCY. BEST OF WORKMANSHIP.

ITS RECORD IS UNEQUALLED.

Special Motors for Mining Purposes.

ELECTRIC HOISTS FOR BUILDING AND DOCK PURPOSES.

The Eddy Electric Mfg. Company,

WINDSOR, CONN.

New York, 33 CHURCH ST., Denver, 1212 EIGHTEENTH ST.,
Boston, 111 ARCH ST., Kansas City, RIALTO BUILDING,
Philadelphia, 506 COMMERCE ST., New Orleans, 78 CUSTOM HOUSE ST.

The Only PERFECT INSULATING SYSTEM FOR UNDERGROUND ELECTRIC WIRES is the

INDURATED FIBRE PIPE,

STRONG, Durable, Absolutely Proof against Moisture, ✳ ✳ ✳ ✳ The Action of Acids and Cases of the Earth.

SUBJECTED TO EVERY PRACTICAL TEST.

UNDERGROUND FOUR YEARS WITHOUT DETERIORATION.

ADDRESS, FOR INFORMATION,

THE INDURATED FIBRE PIPE COMPANY,

Factory, Mechanicsville, N. Y. **Office, 40 Wall Street, NEW YORK.**

THE ELEKTRON MANUFACTURING CO.,

79-81 WASHINGTON STREET, BROOKLYN, N. Y.,

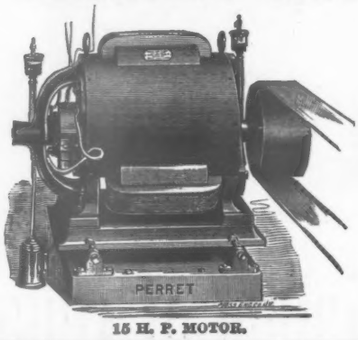
MANUFACTURERS OF

PERRET AUTOMATIC ELECTRIC MOTORS AND DYNAMOS.

EMBODYING LATEST IMPROVEMENTS

And all Desirable Features.

High Standard of Workmanship,
High Efficiency,
Low Speed, Perfect Regulation,
Simplicity.



15 H. P. MOTOR.

MOTORS
FOR RUNNING
Shops, Elevators and Machinery
OF ALL KINDS.

FAN OUTFITS
— FOR —
Battery or Electric Light Circuits.

ISOLATED PLANTS for INCANDESCENT ELECTRIC LIGHTING.

HOLMES, BOOTH & HAYDENS,

MANUFACTURERS OF

BARE AND INSULATED WIRE,

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K."

PATENT "K. K." LINE WIRE

TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

Agents for the WASHINGTON CARBON CO.,

FACTORIES: WATERBURY, CONN.

NEW YORK OFFICE, 25 Park Place,

THOS. L. SCOVILL, NEW YORK AGENT

ELECTRICAL SUPPLIES.

AGENTS FOR OKONITE TRADE MARK
WIRES, TAPE AND CORD, CANDEE WIRES.

DO YOU WANT THE BEST GOODS? DO YOU WANT GOOD PRICES?
DO YOU WANT PROMPT SHIPMENTS?

If so, Write us for Quotations,

SOUTHERN ELECTRICAL SUPPLY COMPANY,

823 LOCUST STREET, ST. LOUIS, MO.

THE AMERICAN CIRCULAR LOOM CO.,

SOLE MANUFACTURERS OF

PATENT WOVEN INSULATED WIRES

THE HIGHEST ABRASION RESISTANCE AND TENSILE STRENGTH WIRE IN THE MARKET.

Western Agents:
THE ILLINOIS ELECTRIC MATERIAL CO.,
Chicago, Ill.

BOSTON, MASS.,
620 Atlantic Avenue.

FARADAY CARBON Co.,
ELECTRIC LIGHT CARBONS, PITTSBURGH. PA.

SUBSCRIBE NOW FOR THE ELECTRICAL REVIEW.

DRILLS

Something New! One, two, three, and four spindle drills for light work.

The most useful patented improvement in drill presses for years is applied

SENSITIVE

Spindles driven with single, endless belts. Large driving pulleys, tightener and variable speeds provided.

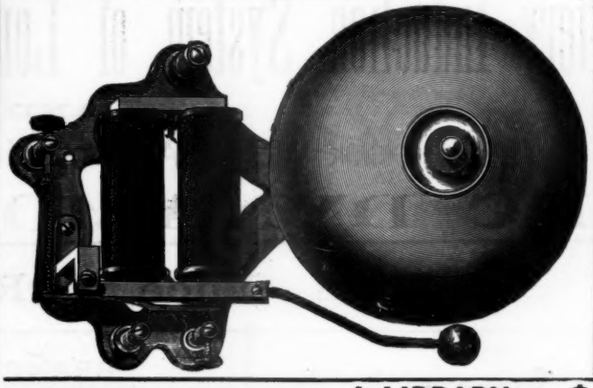
Over 1,000 in use. Buy the **latest** and **best**. Special machinery to order. Catalogue of fine tools free.

Dwight Slate Machine Co.

HARTFORD, CONN.

ROYCE & MAREAN,
DEALERS IN
ELECTRICAL APPARATUS,
Telegraph and Telephone Supplies,
No. 1408 Penna. Avenue,
Opp. Willard's Hotel. WASHINGTON, D. C.

Manufacturers



H. E. & C. BAXTER,
18 Fulton Street, Brooklyn, N. Y.

THE
PARKER-RUSSELL MINING & MFG. CO.
MERMOD-JACCARD BUILDING,
Cor. Broadway and Locust St. Rooms 307 and 308.
ST. LOUIS.

SUNLIGHT CARBONS

UNIFORM IN QUALITY, LONG LIFE AND GOOD LIGHT

SUBSCRIBE NOW FOR THE ELECTRICAL REVIEW.

A LIBRARY FOR $1.00

Five books in one. Worth its weight in gold to every mechanic. The very latest information for 20 different trades. This wonderful book contains 575 pages absolutely teeming with rules, tables, secret processes, and new information that cannot be had elsewhere for less than $25.00. The Modern Steam Engine—How to Read an Indicator—The Westinghouse Air Brake—Blacksmith's and Machinist's Tools—Practical Mathematics Simplified—Tin and Sheet Iron Worker's Manual—Carpenter's Manual—Points for Painters—Magnetism and Electricity—How to Get a Patent—A Mechanical Dictionary. Everything fully explained in one handsome volume and guaranteed to be absolutely correct. Send $1.00 for a copy bound in silk cloth, or $1.50 for Morocco binding. With each copy of the book we give free a complete working chart for setting gear teeth. The regular price of this chart is $1.50. **AGENTS WANTED.** Write for terms. **LAIRD & LEE, Publishers, 203 Jackson Street, Chicago, Ill.**

PAILLARD NON MAGNETIC WATCHES

The Only Watches for Electricians.

FOR SALE BY ALL JEWELERS.

Paillard Non-Magnetic Watch Co.,
192 BROADWAY, NEW YORK.

LEGAL NOTICE.

TO ALL TO WHOM THESE PRESENTS MAY COME, KNOW YE,

By a resolution duly passed by the Corporation known as "Hazazer & Stanley," it was voted to change the name of said Corporation, with permission of the Court, from "Hazazer & Stanley" to "Stanley & Hall."

Now, by order of the Supreme Court, it is made known that from this time the name of said Corporation is and shall be "Stanley & Hall."

A. F. STANLEY,
President.

New York, Sept. 20, 1890.

Washburn & Moen Mfg.
WORCESTER, MASS.
MAKERS OF
IRON AND STEEL
MANUFACTURERS OF
Iron and Copper Wire for Electrical Purposes.
PATENT GALVANIZED TELEGRAPH & TELEPHONE WIRE,
In Long Lengths, Galvanized by our Patent Continuous Process.

The Standard with all Telegraph and Telephone Companies.

Since the first introduction of the Electric Telegraph Service, our patent wire, expressly manufactured for electric purposes, has filled every requisition as regards strength, evenness of quality, and conductive capacity.

Send for Price Lists and descriptive pamphlets, and "Hand-book of Wire in Electric Service." Sent free on application.

New York Warehouse. 16 CLIFF STREET.

Chicago Warehouse, 107 & 109 LAKE ST.

GIVES MORE POWER USING LESS WATER THAN ANY OTHER WHEEL.

THE OLD RELIABLE
—LEFFEL—
WATER WHEEL
SEND FOR CATALOGUE.
JAMES LEFFEL & CO.
SPRINGFIELD, O., OR 110 LIBERTY ST., N.Y.

"Prices are low yet quality tells."

A Corliss Engine

well designed and thoroughly built, is the best the world today possesses.

The Lane & Bodley Co., Cincinnati, O., have a high ideal of what their engines should be, and invite their customers to say what they are. If you want an engine and never have seen one of these, write for descriptive circular.

THE LANE & BODLEY CO.,
CINCINNATI, O.

NEW YORK BELTING AND PACKING CO.

LARGEST BELTS IN THE WORLD.

RUBBER BELTING, PACKING, HOSE,— —MATS, MATTING, STAIR-TREADS.

15 PARK ROW, NEW YORK.
(OPPOSITE ASTOR HOUSE.)
J. H. CHEEVER, TREAS. J. D. CHEEVER DEP'Y. TREAS.

Electrical Testing Apparatus
Manufactured to Order,
Repaired or Calibrated.
WESTERN ELECTRIC CO., NEW YORK.

FORT WAYNE ELECTRIC COMPANY,

FORT WAYNE, IND.

MANUFACTURERS OF THE

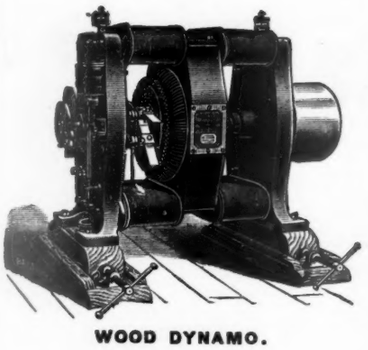
Slattery Induction System of Long Distance Incandescent Lighting

AND THE

Wood Automatically Regulating

ARC DYNAMO AND LAMPS.

Main Office, FORT WAYNE, IND.



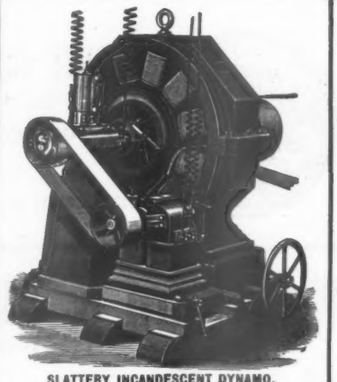
WOOD DYNAMO.

BRANCH OFFICES:

NEW YORK, -	115 Broadway.
PHILADELPHIA,	907 Filbert Street.
PITTSBURGH, PA.,	533 Wood Street.
CHICAGO, - -	185 Dearborn Street.
SAN FRANCISCO,	35 New Montgomery Street.
DETROIT, MICH.,	57 Gratiot Avenue.
TORONTO, CANADA,	138 King Street.
MEXICO, F. Adams' Successors, City of Mexico.	

FACTORIES:

FORT WAYNE, - - - -	INDIANA.
BROOKLYN, - - - -	NEW YORK.



SLATTERY INCANDESCENT DYNAMO.

THE

EMPIRE CITY ELECTRIC Co.

HELMET BRAND. WATER PROOF. WEATHER PROOF.

INSULATED WIRE.

Telegraph, Telephone & Electric Light WIRES AND CABLES.

HARDTMUTH EMPIRE CARBONS.

HARD AND SOFT CORED.

Mason Primary Batteries.

HOUSE WORK MATERIAL.

Batteries, Wire, Bells, Push-buttons, Flexible Cord, Burglar Alarms, Etc., Etc.

ELECTRIC LIGHT MATERIAL.

Poles, Cross-arms, Pins, Insulators, Brackets, Switches, Cut-outs, Lamps, Fixtures, Shades, Shade-holders, Etc., Etc.

ALL KINDS OF

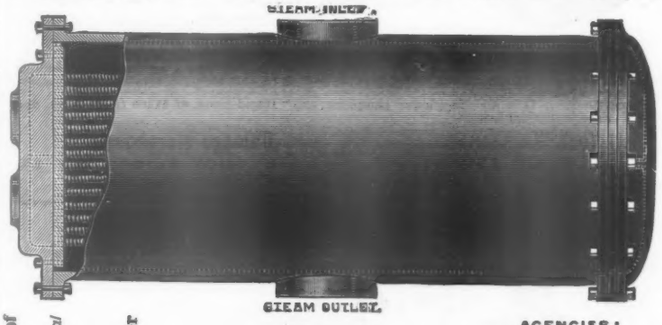
ELECTRICAL SUPPLIES

Send for Wire Price-List and Catalogue to

The Empire City Electric Co., 15 Dey Street, N. Y.

THE IMPROVED

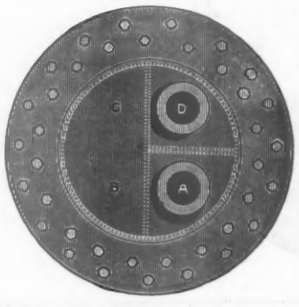
CORRUGATED TUBE FEED WATER HEATER.



The Highest Known Results from the use of Exhaust Steam without Back Pressure.

Coil and Straight Tube, Vertical or Horizontal Feed Water Heaters, Harvard Pump Regulators, Automatic Gauge Valves, Barnard's Separator.

All Heaters and Condensers Sold Under Ten Years' Guarantee.



AGENCIES:

F. B. ASPINWALL, 112 Liberty Street, N. Y.

GEO. CONNER, Mgr., 24 S. 7th St., Philadelphia.

H. S. WALKER, 26-28 W. Randolph St., Chicago.

RUSSELL & CO., St. Paul, Minn.

THE

WAINWRIGHT MANUFACTURING COMPANY,

OF MASSACHUSETTS,

SOLE MANUFACTURERS OF THE

Corrugated Tube Feed Water Heaters, Surface Condensers, Expansion Joints, Expansion Tubes for Compound Engines.

SEND FOR CATALOGUE "A" TO

8 OLIVER STREET (Vulcan Building), BOSTON, MASS.

EDISON LAMPS

16 C. P. - - 44 CENTS EACH.

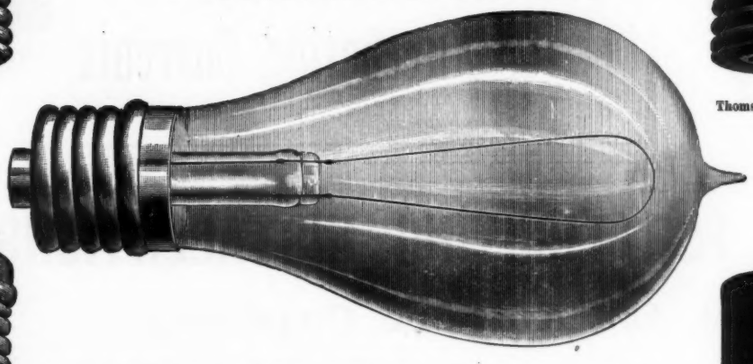
PRICE REDUCED ONE-THIRD!!!

16 C. P. Lamps. 12 to the H. P. 600 Hours Average Life.

No. 1, Edison Base.

The Edison Incandescent Lamp.

No. 2, Thomson-Houston Base.



No. 3, Westinghouse Base.

Unless otherwise specified, all lamps will be shipped with No. 1 bases. The other bases, Nos. 2, 3 and 4 will be placed on lamps, when so ordered, without extra charge.

No. 4, United States Base.

From Nov. 1st, 1890, Subject to Change Without Notice.

16 C. P. Lamps, List Price, 80 Cents Each.		Net Price.			Discounts for Larger Lots Quoted on Application.
Discount in Lots of 25 to 150,	45%	44	cents	each.	
" " 150 to 500,	47½%	42	"	"	
" " 500	50%	40	"	"	

Allowance for Old Bases, $1.35 per 100, f. o. b., Newark, N. J.

Write for Circulars and Price List to Nearest District Office or any Electrical Supply House.

EDISON GENERAL ELECTRIC COMPANY.

MAIN DISTRICT OFFICES.

Eastern District, 16 & 18 Broad Street, New York.
Central District, Rialto Building, Chicago, Ill.
Southern District, Cotton Ex. Bldg., New Orleans, La.
Mountain District, 730 Seventeenth St., Denver Col.
Pacific Dist., Edison Bldg., 112 Bush St., San Francisco, Cal.
Northwestern District, Fleischner Bldg., Portland, Ore.
New England District, 38 Pearl Street, Boston, Mass.
Canadian District, Bank of Commerce Bldg., Toronto, Can.

THE THOMSON RECORDING WATT METER

Simple in Design AND Construction

Direct Reading.

Adapted for Continuous or Alternating Currents.

FOR LIGHTING INSTALLATIONS.

10, 25, 50, 100, 150 Ampere Capacity.

For 50, 75 and 100 Volt Circuits.

FOR MOTOR INSTALLATIONS.

25, 50, 100 and 150 Ampere Capacity.

For 250 and 500 Volt Circuits.

SEND FOR ILLUSTRATED PAMPHLET.

THOMSON-HOUSTON ELECTRIC COMPANY,

620 Atlantic Avenue, Boston, Mass.
405 Sibley Street, St. Paul, Minn.
115 Broadway, New York City.
1110 Noble Street, Philadelphia, Pa.
503 Delaware Street, Kansas City, Mo.
148 Michigan Avenue, Chicago, Ill.
Wall and Loyd Streets, Atlanta, Ga.
215 West Fourth Street, Cincinnati, O.
15 First Street, San Francisco, Cal.
1333 F Street, Washington, D. C.
266 First Street, Portland, Oregon.

The Goodyear Hard Rubber Co.

AND

The India Rubber Comb Co.

(ESTABLISHED 1851.)

ARE the Oldest Manufacturers of Hard Rubber Goods in the World, being the owners and sole manufacturers under the patents of Chas. Goodyear, during their existence. An experience of almost forty years in the fabrication of Hard Rubber, together with unequalled facilities, their works being the largest of the kind in the world, enables them to produce goods of any desired quality, shape or compound, according to the demands of the trade.

THEY MAKE A SPECIALTY OF ARTICLES FOR ELECTRICAL PURPOSES and having manufactured an infinite variety of such goods, are thoroughly equipped for the execution of all orders, particular attention being given to those requiring great exactitude, high finish and superior quality, for which they have a world-wide reputation.

THEIR STORAGE BATTERY CELLS ARE THE STANDARD.

CORRESPONDENCE SOLICITED. ESTIMATES CAREFULLY MADE.

ADDRESS,

The Goodyear Hard Rubber Co., OR The India Rubber Comb Co.,

9, 11 and 13 MERCER STREET, NEW YORK.

ALEXANDER, BARNEY & CHAPIN,

Telephone Building, 20 Cortlandt Street,

NEW YORK.

THE LATEST INCANDESCENT LAMP.

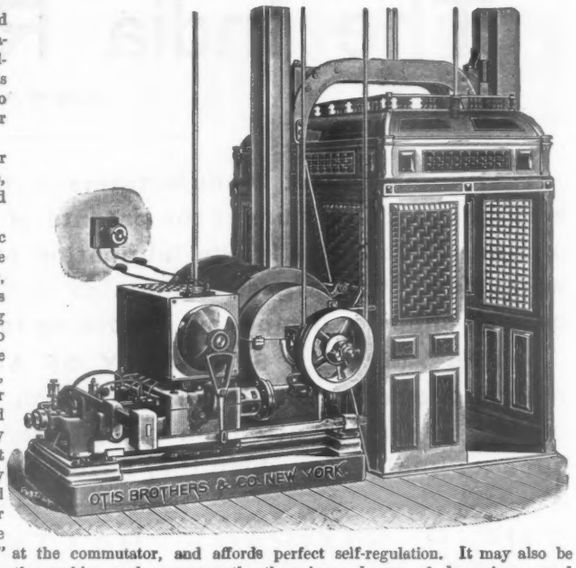
TRY IT. "A·B·C" BUY IT.

EDISON LAMPS AT EDISON PRICES.

General Electrical Supplies, Sockets, Wire, Cut-Outs, Switches, Shades, Fuses.

OTIS ELECTRIC ELEVATOR,

FOR STORES, OFFICE BUILDINGS AND RESIDENCES.



WITH the rapid introduction of electric light and power stations into nearly every city and town in the civilized world, a source of power of unsurpassed cheapness and great reliability has been made available for the performance of work needed for domestic service in buildings of every description; yet, notwithstanding the many advantages of this motive power, its safety, simplicity, extraordinary efficiency, the absence of noise, smell, smoke, ashes and heat, also freedom from liability to damage by frost or by unskilled attendance, its adaption for elevator service presented many difficulties.

Elevator machinery, as a rule, meets with the roughest manipulation while in use. No other apparatus operated by electric power is exposed to such strain—not even in street railway service, where, at least, the same operator is constantly in charge, and a systematic inspection considered indispensable.

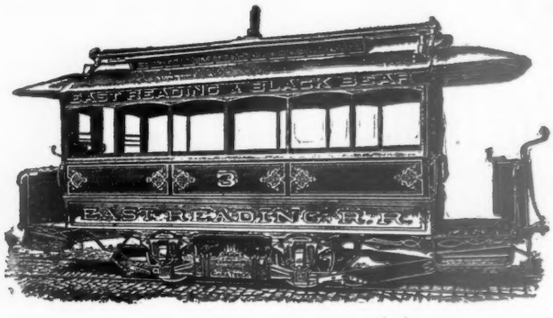
By carefully considering these special conditions, we have succeeded in perfecting an Electric Elevator which is well suited to many places where it has heretofore been impracticable to use such an apparatus. The winding machinery and safety appliances (including the Safety Governor, the Gravity Wedge Safety, the Automatic Stop-motion and the Slack-cable Stop; also the devices for controlling the movement of the elevator car) are such as we have been constantly building for the past 25 years; consequently, in the elevator proper there are no experimental features. To give motion to the elevator machinery, we connect therewith, and make a part of the same, the very ingeniously constructed Motor invented by Mr. Rudolph Eickemeyer, of Yonkers, N. Y., which possesses many novel and meritorious features especially adapted to elevator service, for which it was expressly designed. This Motor, when so combined with the elevator, stops and starts with a gradual movement, and consumes power only in proportion to its load, and only while the elevator is in use, thus effecting the greatest economy in the consumption of power. It possesses in the highest degree the best points of motor construction, and the highest efficiency yet obtained. Simple and accessible in all its parts, of the best material to meet electrical and mechanical requirements, it is also protected by its unique construction, which makes the Motor completely iron-clad without adding any unnecessary weight. It has, further, the special advantage of a powerful field and the shortest possible magnetic circuit, which entirely prevents "sparking" at the commutator, and affords perfect self-regulation. It may also be added that, although it possesses a very strong magnetic field, yet there is no external magnetism in the machine, and, consequently, there is no danger of damaging a good watch, even if placed in contact with the casing. The Motor is so coupled to the Elevator gear that it starts and stops with the winding machinery, the whole being under perfect control of the operator in the car, thus forming a self-contained apparatus, free from jerky and irregular running of detached gearing, as when operated by belts.

After several years of careful study and practical experiment, and having had several of these machines in actual service for a number of months, we are prepared to offer elevator users the first Electrical Elevator that we have found to be successful in meeting the important requirements of easy and gradual starting and stopping of the car, concurrent action of motor and winding machinery, and utmost economy of operation.

OTIS BROTHERS & CO.. 38 Park Row, New York.

ALSO MANUFACTURERS OF THE

STANDARD HYDRAULIC PASSENGER AND FREIGHT ELEVATORS AND STEAM ELEVATORS.



JOHN STEPHENSON COMPANY

LIMITED,

NEW YORK.

Street Cars

FOR

Electric Motors.

Industries.

A Journal of Engineering, Electricity and Chemistry

FOR THE

MECHANICAL AND MANUFACTURING TRADES.

PUBLISHED EVERY FRIDAY.

ANNUAL SUBSCRIPTIONS.	Thick Paper.	Thin Paper.
GREAT BRITAIN, Post Free	$6 00	$6 00
THE UNITED STATES, CANADA and COUNTRIES INCLUDED IN THE POSTAL UNION, Post Free	9 00	8 00
INDIA, CEYLON, STRAITS SETTLEMENTS, CHINA, JAPAN, &c., Post Free	10 75	9 00

SUBSCRIPTIONS PAYABLE IN ADVANCE TO

GEO. CAWLEY, 358 STRAND, LONDON, W. C.

Manchester, 70 Market St.; Glasgow, 93 Hope St.; Yokohama (Japan), 32 Main St.

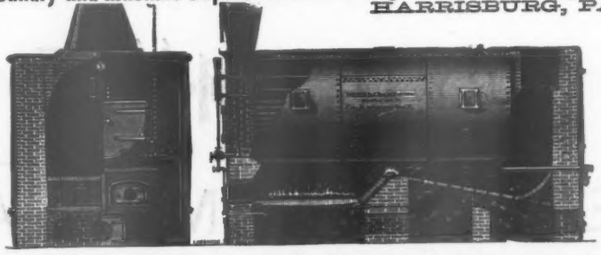
American Subscriptions to "Industries" are received by the Publisher of the ELECTRICAL REVIEW, 13 Park Row, New York.

Weitmyer Patent Furnace,

MANUFACTURED AND SOLD BY

Foundry and Machine Department Harrisburg Car Manufacturing Co.

HARRISBURG, PA.

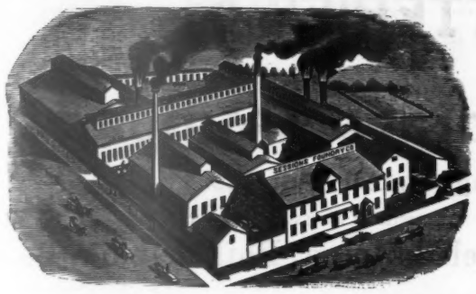


IDE AUTOMATIC ENGINE, PORTABLE & TRACTION ENGINES.

STEAM ROAD ROLLERS, BOILERS OF ALL DESCRIPTIONS.

New York Office, Messrs. W. R. Fleming & Co., 174 Fulton Street.
New England Office, Messrs. John Post, Jr., & Co., 70 Kilby St., Boston.
Baltimore Office, Messrs. Thomas K. Carey & Bro., 26 Light St., Balt.

WESTERN OFFICE, MESSRS. ENGLISH, MORSE & CO., KANSAS CITY, MO.



IRON-CASTINGS FOR ELECTRICAL PURPOSES.

We cast Dynamo Magnets of a special mixture of iron that gives much better electrical results than ordinary castings. Also, small castings for Electrical Work, and castings, large and small, for all purposes, of finest quality. OUR PRICES ARE LOW. We run four large cupolas constantly, melting about 35 tons daily. Correspondence solicited.

SESSIONS FOUNDRY CO., Bristol, Conn.

THE BRODIE TREE INSULATOR

CAN BE SET
AT ANY ANGLE DESIRED,
MAKING ALWAYS
Perfect Insulation for Wires,
Manufactured and Sold by
H. E. Swift Manufacturing Co.,
34 OLIVER ST., BOSTON, MASS.

CARBON PLATES & CARBON BATTERIES

ELECTRIC LIGHT CARBONS.

MADE FROM NATURAL GAS BY PATENTED PROCESS.

— ADDRESS —

SOLAR CARBON & MANUFACTURING CO.,

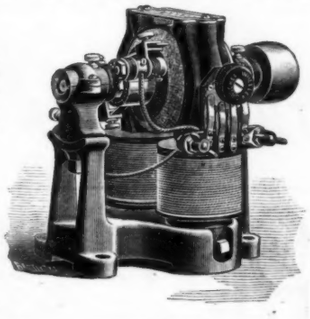
95 & 97 FIFTH AVE., PITTSBURGH, PA.

WHEN Writing for Catalogues, Information or Prices, **YOU WILL CONFER A FAVOR** on both the **ADVERTISER** and the **PUBLISHER** by mentioning the fact that you saw the advertisement in the *ELECTRICAL REVIEW.*

THE CROCKER-WHEELER

PERFECTED

MOTORS.



VERY SLOW SPEED—FULL POWER—PERFECT REGULATION—FORGED FIELDS, LET INTO BASE—SELF-OILING BEARINGS—SELF-CENTERING BEARINGS—ALL SIZES—BOTH ARC AND INCANDESCENT—FOR ALL POWER PURPOSES.

Acknowledged by the leading Manufacturing Companies to be

THE MOST PERFECT MOTOR MADE.

Estimates and Plans Furnished for Electric Power Equipment.

CORRESPONDENCE INVITED.

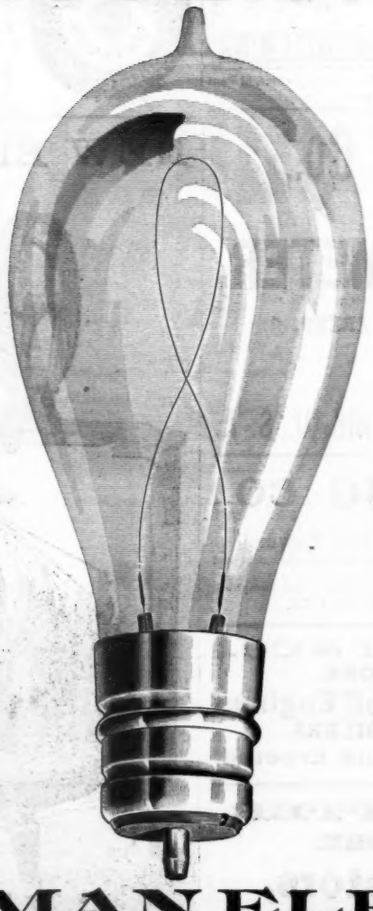
430-432 WEST 14TH STREET, NEW YORK.

S. S. Wheeler, President. F. B. Crocker, Vice-Pres't.

INCANDESCENT LAMPS

To Fit any Socket.

Excelling all others in Life, Maintenance of Candle-Power and Efficiency.



Even Diffusion of Light by Twisted Filament.

From 8 Candle-Power to 150 Candle-Power and any Voltage.

THE BEST IS

General Electrical Supplies of Superior Design and Finish.

THE CHEAPEST

Send for Our Catalogue of August 1st, 1890.

SAWYER-MAN ELECTRIC CO.

620 Atlantic Avenue, BOSTON, MASS.

510-534 WEST 23d STREET, NEW YORK.

217 La Salle Street, CHICAGO, ILL.

JULIEN STORAGE BATTERIES

MANUFACTURED BY

The Consolidated Electric Storage Company,

Exclusive Licensee of the Brush and Julien Storage Battery Patents.

FOR AGENCIES AND LICENSES, ADDRESS THE COMPANY,
120 Broadway, N. Y.

FOR BATTERIES, ADDRESS THE COMPANY,
926 Drexel Building, Philadelphia, Pa.

We have just imported direct a large

STOCK OF MILLING CUTTER BLANKS

(Annealed), forged by WILLIAM JESSOP & SONS, Limited, of their

Best Cast Tool Steel.

Sizes, - - - - - 4 inches diameter, 5-8 inches thick,
To - - - - - 6 " " 2 1-4 " "
Varying by 1-4 inch in diameter and face.

Price, 25 CENTS per lb.

THE GARVIN MACHINE CO.

Laight and Canal Streets, New York.

FAIRBANKS, MORSE & CO., Western Representatives, Chicago, St. Louis, Kansas City, Omaha, Denver, St. Paul
ALBERT FISHER, 89 Liberty Street, New York, Eastern Agent.

THE WALKER ELECTRIC CO.,

MANUFACTURERS OF THE

WALKER ELECTRIC METER,

THE ONLY RELIABLE METER IN THE MARKET,

50 BROADWAY,

EDWIN SCOTT, President,
GEO. W. WALKER, Vice-Prest. & Gen'l Manager,
LEWIS G. TEWKSBURY, Sec'y and Treas.

NEW YORK, U. S. A.

POND ENGINEERING CO.,

ENGINEERS AND CONTRACTORS.

Complete Steam Plants for Electric Light and Power.

Engines, Boilers, Furnaces, Grates, Heaters, Pumps, Injectors, Pipe Work, Belting, etc., designed with special reference to the HIGHEST EFFICIENCY.

Our Extended Experience Enables us to Guarantee Satisfaction. Send for New Illustrated Pamphlet.

ST. LOUIS, CHICAGO, KANSAS CITY, OMAHA, DALLAS AND SEATTLE.

CHARLES R. VINCENT & CO.,

15 CORTLANDT STREET, NEW YORK,

Ball High Speed Automatic Cut-off Engines

MANNING VERTICAL TUBULAR BOILERS,

Complete Steam Plants Furnished and Erected.

WILLIAMS & POTTER,

15 CORTLANDT ST., NEW YORK.

Engineers & Contractors,

GENERAL AGENTS,

STRAIGHT LINE ENGINES

BARNES' PATENT UPRIGHT DRILLS.

20 to 42 inch swing, with both worm and power feed, self-feed back geared.

BARNES' Patent Engine Lathes

BARNES' Water Emery Tool Grinder.

These machines have advantages not found in others of this line.

It will pay parties desiring to purchase or know more about our tools to send for full description and prices to

W. F. & JNO. BARNES CO.
419 Ruby St.
Rockford, Illinois.

PHOSPHOR-BRONZE

INGOTS, CASTINGS & MANUFACTURES.

THE PHOSPHOR BRONZE SMELTING CO. LIMITED
512 ARCH ST. PHILADELPHIA PA. U.S.A.

ORIGINAL MANUFACTURERS OF PHOSPHOR-BRONZE IN THE UNITED STATES AND OWNERS OF THE U.S. PATENTS.

GRIMSHAW WHITE CORE INSULATED WIRE

Grimshaw Patented White Core WIRES and CABLES.

FIRE, ACID, AND WATERPROOF. *GRIMSHAW TAPE.*

NEW YORK INSULATED WIRE Co.,

R. E. GALLAHER, Secretary.
J. W. GODFREY, Gen'l Manager.
W. B. DOWSE, Treasurer.

Sole Manufacturers,
649 & 651 BROADWAY, N. Y.

NEW ENGLAND BUTT CO.,

PROVIDENCE, R. I., U. S. A.,

MANUFACTURERS OF

BRAIDING MACHINERY

FOR COVERING

TELEGRAPH,

TELEPHONE

AND

Electric Light Wire,

LARGE SINGLE AND DOUBLE

BRAIDERS

FOR COVERING CABLES,

Single, Double and Triple

WINDERS,

Horizontal and Upright

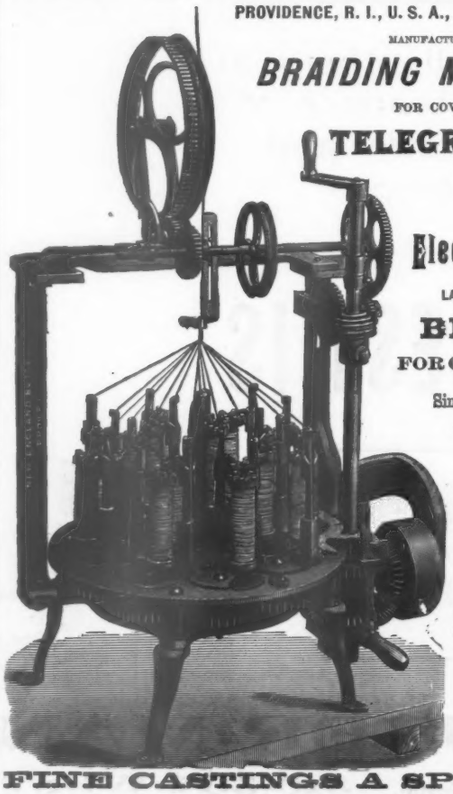
Taping Machines,

Cabling Machines,

Measuring Machines,

Stranding Machines,

Etc., Etc.

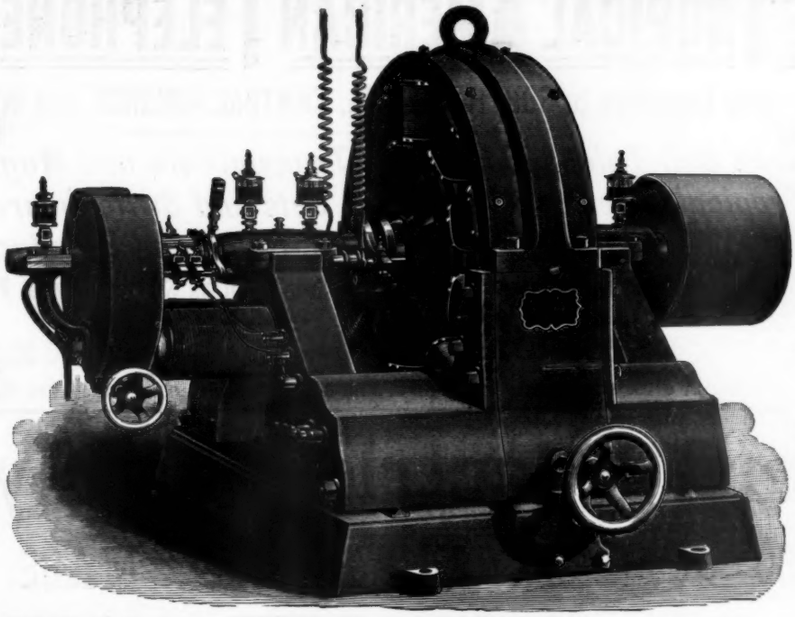


FINE CASTINGS A SPECIALTY.

THE NATIONAL TRANSFORMER SYSTEM
OF INCANDESCENT LIGHTING.

COMPLETE
Central ✳ Station
EQUIPMENTS
FOR
Light or Power
DISTRIBUTION.

COMPLETE
DIRECT CURRENT
SYSTEM
FOR
Isolated Lighting.



OUR APPARATUS
IS OF THE
Highest Efficiency,
MECHANICALLY AND ELECTRICALLY.
We guarantee its operation
AND
Protect our Customers.

We are Prepared to Undertake the
CONSTRUCTION
OF
Electrical ✳ Plants
Of Whatever Magnitude.
CORRESPONDENCE SOLICITED.

NATIONAL ELECTRIC MFG. CO.
Eau Claire, Wis.

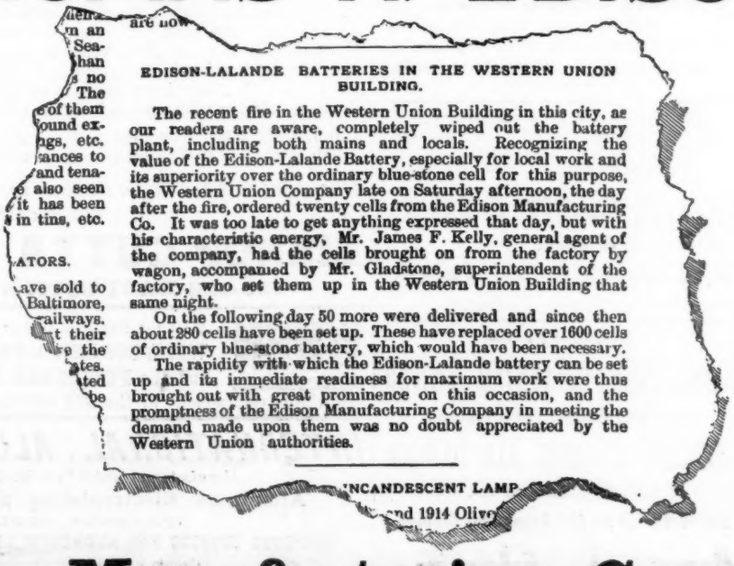
GEO. B. SHAW, - - - - GEN'L MANAGER.

BAKER, BALCH & CO., Gen'l Agts., - - - - - - Seattle, Washington.
THOMAS WOLFE, Southwestern Agt., - - Union Depot Hotel, Kansas City, Mo.
LITTLE, McDONALD & CO., Gen'l Agts., - 141 East Seneca St., Buffalo, N. Y.
METCALF, REED & CO., Western Agts., - - 1517 Larimer St., Denver, Col.
CHAS. M. BLANCHARD, Agent, - - - - - Girard Building, Philadelphia, Pa.
L. N. COX, Agent, - - - - - - 16 Fifth St., S. E., Washington, D. C.
W. N. GRAY, Special Agt., - - Room 12, Chamber of Commerce, Cincinnati, O.
PITTSBURGH ELECTRIC CO., Special Agts., - - 531 Wood St., Pittsburgh, Pa.
NATIONAL ELECTRIC MFG. & CONSTRUCTION CO., - - - - - - - - - - - Tower Building, No. 50 Broadway, New York City.
NATIONAL ELECTRIC DEVELOPMENT CO., - - - - - - - - - - - History Building, 723 Market St., San Francisco, Cal.
SIMPSON-DAVIS ELECTRICAL CONSTRUCTION CO., Agents, - - - - - - - - - Winnipeg, Manitoba.
A. IRVINE, Agent, - Emelie Building, St. Louis, Mo.

THE NEW
EDISON-LALANDE BATTERY.

MANUFACTURED UNDER AUTHORITY OF

THOMAS A. EDISON.



EDISON-LALANDE BATTERIES IN THE WESTERN UNION BUILDING.

The recent fire in the Western Union Building in this city, as our readers are aware, completely wiped out the battery plant, including both mains and locals. Recognizing the value of the Edison-Lalande Battery, especially for local work and its superiority over the ordinary blue-stone cell for this purpose, the Western Union Company late on Saturday afternoon, the day after the fire, ordered twenty cells from the Edison Manufacturing Co. It was too late to get anything expressed that day, but with his characteristic energy, Mr. James F. Kelly, general agent of the company, had the cells brought on from the factory by wagon, accompanied by Mr. Gladstone, superintendent of the factory, who set them up in the Western Union Building that same night.

On the following day 50 more were delivered and since then about 280 cells have been set up. These have replaced over 1600 cells of ordinary blue-stone battery, which would have been necessary.

The rapidity with which the Edison-Lalande battery can be set up and its immediate readiness for maximum work were thus brought out with great prominence on this occasion, and the promptness of the Edison Manufacturing Company in meeting the demand made upon them was no doubt appreciated by the Western Union authorities.

INCANDESCENT LAMP
and 1914 Olive

Edison Manufacturing Company,
JAMES F. KELLY, General Sales Agent, 19 DEY STREET, NEW YORK.

GENUINE TELEPHONES FOR EXPORT.

THE TROPICAL AMERICAN TELEPHONE COMPANY

Sole Exporters to SOUTH AMERICA, CENTRAL AMERICA and WEST INDIES.

American Bell Telephones, Blake Transmitters and Magnetos.
Tropical American Telephone Sets and Switchboards of all Sizes.
"Williams" Magneto Call-Bells, and Standard Switchboards.

Patented Telephonic Apparatus and Supplies of all Sorts at Lowest Prices.

Send for New Illustrated Catalogue and Price List to

New York Office, direct: No. 18 Cortlandt St. – OR – Boston Office: No. 95 Milk St., Box 3318, P. O.

THE E. S. GREELEY & CO., J. H. BUNNELL & CO. AND B. BLUM & CO., ALSO SELL OUR INSTRUMENTS, DESTINATION BEING GIVEN.

Standard Electric Supply Co.,

180 SUMMER ST., BOSTON, MASS.

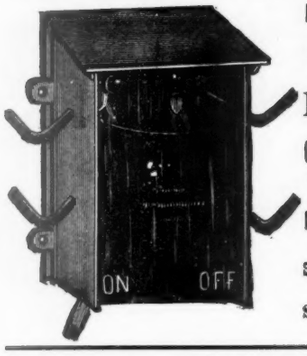
Electric Supplies and Latest Specialties

FOR

ELECTRIC LIGHTING, ELECTRIC RAILWAYS.

SOLAR CARBONS FOR ARC LIGHTING. CARBON BRUSHES FOR DYNAMOS & MOTORS.

THE E. S. GREELEY & CO.,



Nos. 5 & 7 Dey St., New York

Manufacturers and Importers of and Dealers in

Telegraph, Telephone – AND – Electric Light Supplies

AGENTS FOR

Cleveland Arc Light Cut Outs & Gang Switches

Cleats, Rosettes, Moulding, Pins, Cross-Arms, Brackets. Insulating Tapes.

Rubber, Porcelain and Glass Insulators

WIRES OF ALL KINDS.

Silk & Cotton Covered Flexible Conducting Cord of various sizes for Incandescent Lighting.

Spikes, Pole Steps, Lag Screws, Drive Screws, Turn Buckles, Etc.

C. J. FIELD, M. E., Pres't and Chief Eng'r. W. D. MAC QUESTEN, Consulting Eng'r. J. B. CRAVEN, Asst. Eng'r. E. F. WHITE, M. E., V. P. and Mech. Eng'r.
J. W. CRAWFORD, Secretary. F. UHLENHAUT, Jr., M. E., Asst. Eng'r. F. BOURNE, Electrical Eng'r.

Field Engineering Company,

15 CORTLANDT STREET, NEW YORK.

Consulting and Contracting Engineers. Complete Equipment of Electric Street Railways.

STEAM POWER PLANTS. STATION CONSTRUCTION. CONDUITS.

HILL'S

DOUBLE-POLE CONVERTER SWITCH

Opens both Poles of Primary Circuit,

THEREBY AVOIDING ALL DANGER

WHILE WORKING ON THE

Converter or on the Secondary Circuit.

W. S. HILL,

133 OLIVER ST., BOSTON, MASS.

EXTRACT FROM THE REPORT

— OF —

DR. SCHUYLER S. WHEELER,

— ON —

Underground Arc Light Wires in New York.

The line in 125th Street, 2,000 feet in length, is laid in the small ducts of the Johnstone system of conduits. The cable is a *BISHOP GUTTA PERCHA WHITE CORE*, and was laid immediately after the order for the work was given. The cable was connected to overhead arc light wires by running it up in a two-inch iron pipe fastened to the outside of an ordinary city electric lamp post. Connections were made with lights in front of stores by carrying the cable from the ducts in iron pipes under the sidewalk and up the front of the stores. This line has been in continuous use for two months, carrying a pressure of 2,500 volts, and it shows an actual rise in insulation with age and use, as will be seen from the following tests:

Jan. 11th, 1,100 Megohms.
Feb. 12th, 1,800 Megohms.
April 12th (including eight arc lamps and branch leads), 2,000 Megohms.

All our White Core India Rubber Insulation is Same Quality as on above cables.

BISHOP GUTTA PERCHA CO.,

420-426 EAST 25TH ST., NEW YORK.

WHEN Writing for Catalogues, Information or Prices, YOU WILL CONFER A FAVOR on both the ADVERTISER and the PUBLISHER by mentioning the fact that you saw the advertisement in the *ELECTRICAL REVIEW*.

INTERNATIONAL ALUMINUM WORKS,

Manufacturers, under Prof. H. G. Coyle's Processes, of

Aluminum Electroplating Solutions and Anodes.

(PATENTS APPLIED FOR.)

COMPLETE OUTFITS FOR ALUMINUM ELECTROPLATING A SPECIALTY.

County and State Rights Sold. No Royalty.

Offices, 36 & 38 JOHN STREET, NEW YORK, U. S. A.,

And 86 New Street, Birmingham, England.

LABORATORY AND SHOW ROOMS, 53 MAIDEN LANE, NEW YORK.

AMERICAN AND FOREIGN BOOKS ON ELECTRICITY AND ITS APPLICATIONS.

Electricity, Magnetism, Etc., Etc.

Adams. Essay on Electricity $4 00
Angell. Elements of Magnetism and Electricity. Cloth, 238 pages, 151 illustrations 75
Anderson. Lightning Conductors. Cloth 6 50
Atkinson. Elements of Static Electricity 1 50
Ayrton. Practical Electricity. For students of electrical engineering. 516 pages, 180 illustrations 2 50
Barlow. Magnetic Attractions 4 00
Barnard. First Steps in Electricity 75
Benjamin. Age of Electricity 2 00
Brennan. A Popular Exposition of Electricity. 191 pages 75
Blakesley. Alternating Currents of Electricity. Cloth 1 50
Bottone. The Dynamo. How Made and How Used. A book for amateurs. Cloth. 1 00
Cavendish. Electrical Researches. Cloth 5 00
Cook. Magnetism and Electricity. Cloth, 48 illustrations 40
Cumming. Electricity Treated Experimentally. Cloth, 100 diagrams 1 50
Davis. Manual of Magnetism, Galvanism, etc 3 00
Deschanel. Electricity and Magnetism. Cloth 1 50
De Fonvielle. Thunder and Lightning. Cloth, 285 pages 1 00
De La Rue. Experimental Researches in the Electric Discharge with the Chloride of Silver Battery 3 60
Du Moncel. Electro-Magnets. Boards, 50c.; English Edition 75
Dunman. Short Text Book of Electricity and Magnetism 40
Dyer. Induction Coils; How Made and How Used. Boards 50
Electricity in the Service of Man 6 00
Everett. Units and Physical Constants 1 10
Faraday. Experimental Researches in Electricity. 3 vols., cloth 20 00
Fiske. Electricity in Theory and Practice. Cloth, 270 pages, 180 illustrations 2 50
Ferguson. Electricity. Cloth 1 50
Fleming's. Short Lectures to Electrical Artisans 1 50
Francis. Electrical Experiments 2 50
Gordon. School Electricity. Cloth, 262 pages, 139 illustrations 2 00
Gordon. A Physical Treatise on Electricity and Magnetism. 2 vols., cloth 10 00
Gladstone & Tribe. The Chemistry of the Secondary Batteries of Plante and Faure. 1 00
Gordon. Four Lectures on Static Electric Induction. Cloth 80
Guthrie. Magnetism and Electricity 1 25
Hamilton. The Origin of Energy, Electrostatics and Magnetism 2 00
Heap. Electrical Appliances of the Present Day. Cloth 2 00
Hospitalier. Domestic Electricity. Cloth, 229 pages, 155 illustrations 3 00
Hospitalier. The Modern Applications of Electricity. Cloth 8 00
Harris. Rudimentary Electricity. Flexible, 69 illustrations 60
Harris. Rudimentary Magnetism. Cloth, 165 illustrations 1 40
Harris. Galvanism, Animal and Voltaic Electricity 60
Hering. Winding Magnets for Dynamos. 63 pages 1 25
Jeans. Lives of the Electricians 2 25
Jenkin. Electricity and Magnetism. Cloth, 177 illustrations 1 50
Kirwan. Modern Electricity with Glossary of Electrical Terms. 128 pages 30
Kohlrausch. Physical Measurements, with Appendices on Absolute Electrical Measurements 6 00
Lardner. Hand-Book of Electricity, Magnetism and Acoustics. 400 illustrations, cloth 2 00
Levander. Solutions of Questions in Magnetism and Electricity. Cloth 1 00
Lightning Flashes and Electric Dashes 1 00
Lloyd. Treatise on Magnetism 5 00
Lock. Workshop Receipts. Devoted mainly to Electrical and Metallurgical subjects. Cloth 2 00
Mahon. Principles of Electricity 5 00
Martin & Wetzler. Electric Motor and its Applications. 208 pages, 199 illustrations. 3 00
Mascart & Joubert. A Treatise on Electricity and Magnetism. Vol. 1, cloth, 654 pages, 127 illustrations 7 50
Maxwell. A Treatise on Electricity and Magnetism. 2 vols., 20 plates and 105 illustrations 8 00
Maxwell. An Elementary Treatise on Electricity. 6 plates, 54 illustrations 2 00
May. Bibliography of Electricity 2 00
McClure. Edison and his Inventions 1 00
Mendenhall. A Century of Electricity 1 25
Merwin. Patentability of Inventions 6 00
Miller. Magnetism and Electricity. 212 pages, illustrated 2 50
Munro. Electricity and its Uses. Cloth 1 40
Murdock. Notes on Electricity and Magnetism. Cloth, 38 illustrations 60
Munro & Jamieson. Electrician's Pocket-Book of Electrical Rules and Tables 2 50
Niaudet. Elementary Treatise on Electric Batteries. Cloth, 55 illustrations 2 50
Nipher. Theory of Magnetic Measurements 1 00
Noad. The Student's Text-Book of Electricity. Cloth, illustrated 4 00
Overend. Elementary Experiments in Magnetism and Electricity. Cloth 40
Parkinson. Ocean Telegraph to India 4 00
Parnell. Action of Lightning and Means of Defending Life and Property from its Effects 3 00
Plante. Storage of Electrical Energy. 268 pages, 89 illustrations 4 00
Pynchon. Introduction to Chemical Physics. 550 pages, 269 illustrations 3 00
Radau. Wonders of Acoustics; or, The Phenomena of Sound. Cloth, 288 pages, 116 illustrations 1 00
Rankine. Rules and Tables for Engineers 4 00
Reports of the Committee on Electrical Standards. Cloth 3 75
Rogers. Magnetism of Iron Vessels 50
Salomons. The Management of Accumulators 1 20
Spang. Treatise on Lightning Protection. Cloth, illustrated 75
Stewart & Gee. Electricity and Magnetism. 497 pages, 223 illustrations 2 25
Swinburne. Practical Electrical Units Popularly Explained. Cloth 60
Tarn. Magnetism and Electricity. A book for students 80
Techno-Chemical Receipt Book 2 00
Thompson. Elementary Lessons in Electricity and Magnetism. Cloth, 168 illustrations 1 25
Thompson. Recent Progress in Dynamo Electric Machinery 50
Thomson. Electro-Statics and Magnetism 5 00
Treglohan. Frictional Electricity 50
Tyndall. Lessons in Electricity at the Royal Institute, 1875-6. Cloth 1 00
Watson and Burbury. The Mathematical Theory of Electricity and Magnetism. Cloth, 268 pages 2 75
Wonders of Acoustics; or, The Phenomena of Sound. Cloth, 288 pages 1 00
Woodbury's Protection and Construction of Mill Floors. Cloth 2 50
Welch. Table of Relative Weights of Copper Conductors 10
Woodward. Arithmetical Physics. Boards 80

Telegraphy and Telephony.

Abernethy. Commercial and Railway Telegraphy. Illustrated, cloth 3 00
Beechey. Electro-Telegraphy. Cloth. 36 illustrations 40
Clarke & Sabine. Electrical Tables and Formulæ. Cloth 5 00
Culley. Hand-Book of Practical Telegraphy. Cloth, 442 pages 6 00
Davis & Rae. Hand-Book of Electrical Diagrams and Connections 2 00
Douglas. A Manual of Telegraph Construction. 83 diagrams, cloth 6 00
Fahie. History of Telegraphy to 1837. Cloth, 529 pages 3 00
Field. History of Atlantic Telegraph 1 25
Globe Telegraph Code 2 00
Hoskiaer. Laying and Repairing Electric Telegraph Cables. Cloth 1 50
Hoskiaer. A Guide for the Electric Testing of Telegraph Cables. Cloth 1 50
Jones. Historical Sketch of the Electric Telegraph 2 00
Lardners. Electric Telegraph Popularized 1 50
Lockwood. Electricity, Magnetism and Electric Telegraphy. Cloth, 376 pages 2 50
Loring. A Hand-Book of the Electro-Magnetic Telegraph. Boards, 50c.; cloth, 75c.; morocco 1 00
Maver & Davis. The Quadruplex. Cloth, 126 pages 1 50
Mullaly. Laying of the Cable 4 00
Pope. The Modern Practice of the Electric Telegraph. Cloth, 70 illustrations 1 50
Plum. The Military Telegraph During Our Civil War. Two vols., portraits and illustrations 5 00
Preece & Silveright. Telegraphy. Cloth 1 50
Prescott. Electricity and the Electric Telegraph. Cloth, 670 illustrations, 2 vols. 5 00
Sabine. History and Progress of the Electric Telegraph. Cloth, 184 illustrations. 1 25
Sauer. Telegraph in Europe 4 00
Schwendler. Instructions for Testing Telegraph Lines. 2 vols., cloth, illustrated. 8 00
Smith. Manual of Telegraphy. 31 illustrations, paper 30
Telegraphic Tests 5 60
Terry & Finn. Illustrations and Descriptions of Telegraphic Apparatus. Cloth, 92 pages, 30 plates 1 50
Williams. Manual of Telegraphy. Cloth, 327 pages, 90 illustrations 4 00
Dolbear. The Telephone. Cloth, illustrated 50
Du Moncel. The Telephone, the Microphone and the Phonograph. 70 illustrations, cloth 1 25
Lockwood. Practical Information for Telephonists. Cloth 1 00
Prescott. Bell's Electric Speaking Telephone. 526 pages, 330 illustrations 4 00
Thompson. Philip Reis, Inventor of the Telephone. Cloth, 3 plates and 48 engravings 3 00

Electric Lighting and Transmission of Power.

Alglave & Boulard. The Electric Light. Its History, Production and Application. 458 pages 5 00
Atkinson. Elementary Principles of Electric Lighting 1 50
Badt. Dynamo Tenders' Hand-Book. General Rules for the Care and Operation of Electric Light Plants. 70 illustrations, 93 pages 1 00
Badt. Incandescent Wiring Hand-Book 1 00
Cunynghame. A Treatise on the Law of Electric Lighting. Cloth 5 00
Day. Electric Light Arithmetic. Cloth 40
De Cew, Glacer. Magneto and Dynamo Electric Machines 3 00
Du Moncel. Electric Lighting. 66 illustrations, cloth 1 25
Dredge. Electric Illumination. 2 vols., cloth. Vol. 1 (scarce), $15. Vol. 2 ..... 7 50
Electric Lighting Act, 1882, also the Rules of Board of Trade, October, 1882 ..... 2 00
Foote. Economic Value of Electric Light and Power. 191 pages 1 00
Gordon. A Practical Treatise on Electric Lighting. Cloth 4 50
Grierson. Electric Lighting by Water Power 40
Hedge. Precautions to be Adopted on Introducing the Electric Light 1 00
Hedges. Central Station Lighting. Paper 20
Holmes. Practical Electric Lighting. Cloth 1 00
Higgs. Magneto and Dynamo Electric Machines. 301 pages 2 00
Kapp. Alternate Current Machinery 50
Maier. Arc and Glow Lamps 3 00
Pope. Evolution of the Electric Incandescent Lamp 1 00
Prescott. Dynamo-Electricity. Cloth 5 00
Stephen. Wrinkles in Electric Lighting. Cloth, 45 pages, 23 illustrations 1 00
Schellen. Magneto-Electric and Dynamo Electric Machines. Cloth 5 00
Schilling. Present Condition of Electric Lighting 50
Thompson. Dynamo-Electric Machines. Illustrated, boards 50
Thompson. Dynamo-Electric Machinery. 57 illustrations, boards 50
Thompson. Dynamo-Electric Machinery. Cloth, 527 pages, 324 illustrations 5 00
Thompson. Recent Progress in Dynamo-Electric Machinery 50
Thurston. Stationary Steam Engines, especially as adapted to Electric Lighting Purposes 2 00
Urquhart. Electric Light: its Production and Use. Cloth, 94 illustrations 3 00
Du Moncel. Electricity as a Motive Power. Cloth 3 00
Kapp. Electric Transmission of Energy and its Transformation 3 00
Urquhart. Electro-Motors. Illustrated 3 00
Walker. Practical Dynamo Building for Amateurs 80
Whipple. The Electric Railway 1 00

Testing and Measurements.

Haskins. The Galvanometer and its Uses. Morocco, 8 illustrations 1 50
Kempe. A Hand-Book of Electric Testing. Cloth, 494 pages 5 00
Lockwood. Electrical Measurements and the Galvanometer. Cloth 1 50
Smith's. Dynamometric Measurements 40
Swinburne. Practical Electrical Measurement. 55 illustrations, 155 pages 1 75

Electro-Metallurgy, Electrotyping, Etc., Etc.

Badt. Bell Hanger's Hand-Book. Practical Information and Suggestions to persons having Charge of Batteries, Bells, Annunciators and Electric Gas Lighting Apparatus. 105 pages, 97 illustrations 1 00
Bottone. Electric Bells and All About Them. Practical Instruction for Electric Bell Fitters. Over 100 illustrations, 190 pages 1 20
Bottone. Electrical Instrument Making for Amateurs 2 00
Fontaine. Electrolysis. Cloth, 264 pages 3 50
Gore. The Art of Electro-Metallurgy. Cloth, illustrated 2 25
Napier A Manual of Electro-Metallurgy. Cloth 3 00
Urquhart. Electrotyping. A Practical Manual 2 00
Urquhart. Electroplating. Cloth 2 00
Wahl. Galvanoplastic Manipulations. Cloth 7 50
Watt. Electro-Metallurgy Practically Treated. Cloth 1 00
Watt. Electro-Deposition. Cloth, 568 pages, 144 illustrations 3 50
Wilson. Stereotyping and Electrotyping. Cloth, 195 pages 2 00

☞ Copies of any of the above books will be promptly mailed, POSTAGE PREPAID, to any address in the world on receipt of price. Remit by Express or Post Office Money Order, Postal Note, Draft or Registered Letter. Address

ELECTRICAL REVIEW PUB. CO.,

P. O. BOX, 3329. 13 PARK ROW, NEW YORK.

CROSBY ELECTRIC COMPANY.

PRINCIPAL OFFICE,
87 & 89 SOUTH FIFTH AVENUE, NEW YORK.

CROSBY DRY BATTERIES

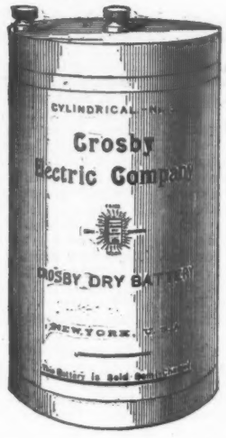
FOR OPEN CIRCUIT WORK.

ELECTRO-MOTIVE FORCE, 1.55 VOLTS. CURRENT, 1 TO 15 AMPERES.

RECTANGULAR, CYLINDRICAL, TELEPHONE.

MADE IN ALL SHAPES AND SIZES.

RECUPERATE OFTENER AND QUICKER THAN ANY OTHER.



NEAT. = CLEAN. = EFFECTIVE. = SIMPLE. = COMPACT. = PORTABLE.

IT IS THE BEST ON THE MARKET.
IT HAS MORE ADVANTAGES THAN ANY.
IT IS SOLD SEMI-CHARGED.
IT DOES NOT DIE ON THE SHELF.
IT IS NOT AFFECTED BY TEMPERATURE.
IT IS NOT DESTROYED BY SHORT CIRCUIT.
IT IS THE MOST RELIABLE.
IT PERFORMS THE MOST WORK.

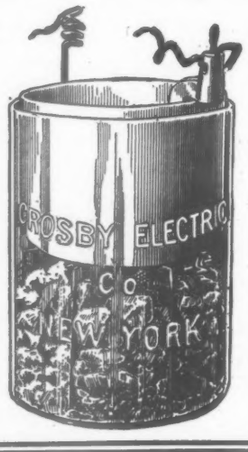
FOR TELEPHONES, ANNUNCIATORS, GAS LIGHTING, HOUSEWORK, MEDICAL PURPOSES.

THE HUSSEY BLUE STONE.

The Only Blue Stone Battery that can be used for open circuit work.

No Consumption of Blue Stone when not in use.

For Charging Storage Batteries, Running Sewing Machines, Small Incandescent Lamps, Fans, Dental Machines, Telegraphing.



Can be completely recharged without dismounting.

No Deposit of Copper on Zinc.

Gives 10 Times the Current of Any.

For Running Motors.

For All Uses.

THIS IMPROVEMENT CAN BE APPLIED TO ALL FORMS OF BLUE STONE JARS AT PRESENT IN USE.

THE DUPLEX.

Its two cells occupy only the space of one, thereby giving a voltage in the space of one cell, equal to that obtained by any other two cells requiring double the space.

**For Housework,
Bells,
Burglar Alarms,
Etc.**

No Climbing Salts.

Always Clean.

Recuperates Quickly.

Large Zinc Surface.

Is rapidly taking the place of all other Open Circuit Liquid Batteries.

THE ECLIPSE.

**Intended for Close Circuit Work.
Will Not Polarize.
Pure Water only Necessary to Charge It.
The Simplest and Cleanest Close Circuit Battery in the World.**

**No Fumes.
No Odor.**

**For Small Motors.
Small Lamps.**

For Doctors' and Dentists' Use.

Induction Coils, Etc., and all purposes where a Constant Current is required for continuous or intermittent work.